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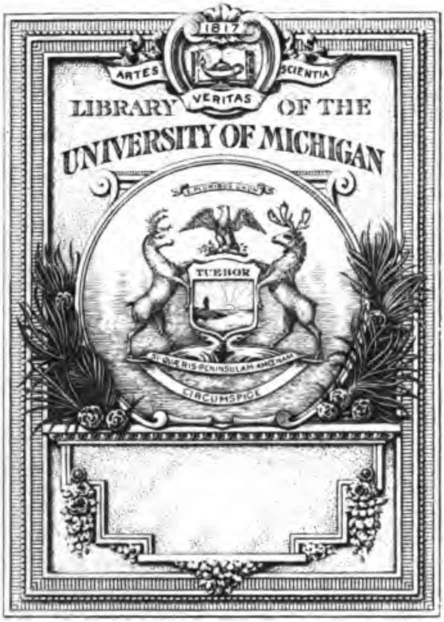
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ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. CLXIX. SECOND SERIES. June 1816.

Specification of the Patent granted to EDWARD CHARLES HOWARD, *of Nottingham-place, in the Parish of Saint Mary-le-Bone, in the County of Middlesex, Esquire; for certain Means of separating insoluble Substances from Fluids, in which the same are suspended.*

Dated August 4, 1814.

With a Plate.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Edward Charles Howard do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, are particularly described in manner following; that is to say: in the drawing hereunto annexed, the same numerical and alphabetical characters or letters do every where denote the same things respectively; and Fig. 1, (Plate I.) in two outlines, shews by section a vessel, wherein the said fluid, in which insoluble substances are or may be suspended, is to be put.

The inner circle *b b*, Fig. 1, plan, denotes a pipe, having many small perforations through the sides thereof, and of such length, that the upper end thereof shall ex-

tend

tend above the fluid contained in the vessel *f g*, and the lower end shall pass through, and be properly, but not immoveably, fixed in the bottom of the vessel at *p p*, as is more fully shewn in Fig. 1, section. The dotted line in this figure shews the level of the fluid. The space between the circles *c c* and *d d* is occupied by a float, which environs the pipe aforesaid; and the same, having openings at *o o*, and being at liberty to rise and fall along with the fluid, does admit the said fluid through the said openings into the pipe *b b*: and in order that the said fluid may pass wholly, or for the most part a little, below the surface of the fluid; through the said openings a tubular bag, kept distended by rings *r r r r r r*, is fastened to the float at top, and to the vessel or the pipe at bottom *p p*. And, farther, the letters *e e* represent a pipe or cage, or other similar contrivance, for preventing the access of coarse impurities from arriving at *o o*. The pipe *b b* terminates below at *h*, where there is an opening, for occasionally drawing off the contents of the vessel; but in the act or process of separation of insoluble substances the fluid is allowed to pass through the side pipe and cock *i*, through *l*, into the receptacle or filter Fig, 2, with more or less of velocity, as the said cock may be more or less open. And the said velocity is ascertained, or practically estimated, by means of the stand pipe *k k*, which has communication with *l*, and shews the elevation of the column of pressure by the float *m*, and a small counterweight *n* attached to a line or cord passing over a pully *q*, which serves as an index.

The filter, Fig. 2, is closed on all sides, excepting at the cocks *x*, *y*, and *z*, of which *x* suffers the escape of included air, and shews when the filter is filled, and is thereby in the best state for working or beginning to draw off at the cock *y*, which draws off the fluid after filtration

tion with a velocity which is greater the greater the pressure may be, as indicated by the float *m*.

Fig. 3 shews the construction of the filter. The external part, which is a strong case, box, or vessel, contains a large or considerable number of filtering frames, which are represented by an end section in Fig. 8, numbers 9 and 10, and in Figs. 3 and 4, No. 14, and in part of the full size *, by an horizontal section in Fig. 6. Where the forms are varied, the external lines in Fig. 8, and the dotted lines in Fig. 6, indicate a covering of linen, cotton, woollen, leather, silk, or other flexible material, permeable, or made permeable to fluids, and closed at the edge or side 9, and at the two other adjacent sides of the frames, but attached to the fourth edge or side at 10, by lacing or otherwise, and covered completely round the flat side or border 28 (but not the edge) with list, or other elastic coating. The interior lines shew, by a section, the frame or platform upon which the covering of flexible material is supported; and the said frame or platform is constructed in such a manner as to render the parts which support the surface of the said flexible and permeable material as small as possible; and the said frame is also perforated in such directions, 29, or left open in parts, as to allow any fluid which shall or may pass into the said framed structure, to flow freely downwards and out from the lower part of the same.

Fig. 3 shews the filter, with a due charge or quantity of frames.

Fig. 4 shews the manner and method of putting the said frames in their places when numerous.

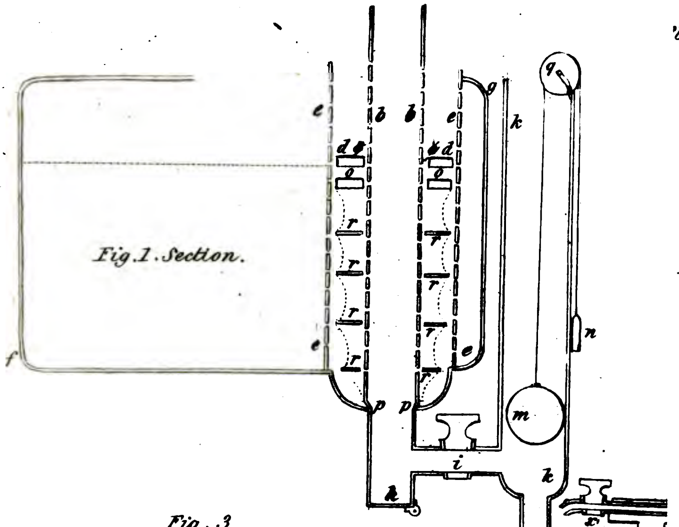
Fig. 5 is a piece or implement, consisting of a small number of battens 26, 26, 26, 26; and 27 is a shallow upright ledge, covered with list, or other elastic coating;

---

* The engraving is exactly half the size of the inrolled drawings.

and the said piece or implement serves to support a number or set of the filtering frames; and the sides and end of the receptacle or filtering vessel being cloathed or cushioned at and round the lower part 31 of the interior surface, with list or other elastic material, so as to fit the filtering frames, it follows, that when a number of the said frames are strongly compressed together the communication between the spaces left between frame and frame, and above the said frames, and between the space which shall or may be left below the said frames, will be intercepted and cut off, excepting so far as such communication shall or may continue to take place through the said covering or coverings of flexible and permeable material, or the pores thereof. In Fig. 2 the pipe *l* delivers the turbid liquor or fluid into the space first above mentioned, and the cock *y* delivers the fluid, after percolation, through the filter, by which the said fluid is rendered clear, in consequence of the separation of the insoluble substances, and the said substances are retained and preserved upon the filter or the covering of the frames; and the cock *z* communicates with the space so appropriated for turbid liquor, and is used occasionally for drawing off the same.

Fig. 4 shews the method of forcing the frames by sets, of about ten at a time to their due situation by strong pressure; 23 is a strong board, having the face thereof nearly as long as the width of the filtering frame, and provided with a metallic rack of ratchet teeth; 22 is a claw piece or bar resting by one of its notches 20, 18, 21, upon the fulcrum in the lever bar 17, 19, which is hooked upon the hinge pin 19, and revolves thereon. At 17 is an adjustable connection between the upper end of the lever 17 and the extremity of one of the coupling bars of another lever, as seen at 13 *a* in Fig. 7. It is manifest that



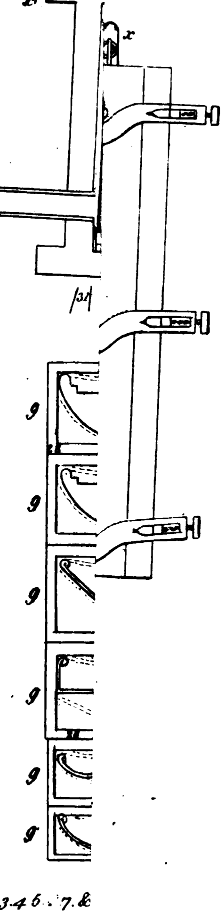


Fig. 3.

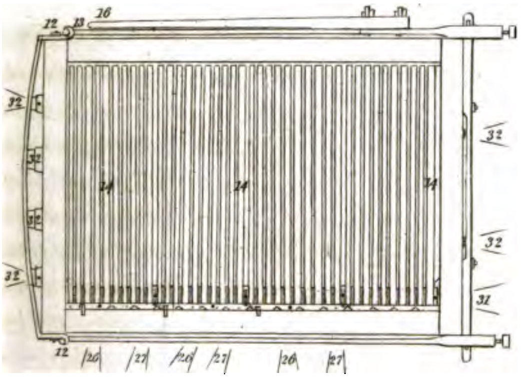
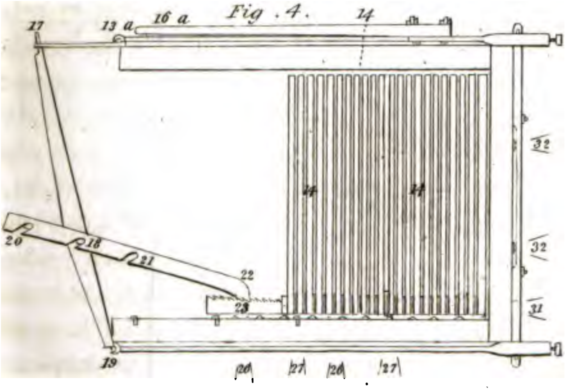


Fig. 4.



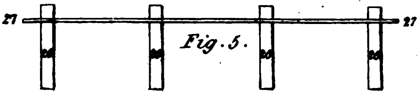


Fig. 5.

Scale of Figs. 1.2.3.4 6 . 7.&

that by drawing home the lever 16 *a*, an immense pressure will be gained, and the frames will be thereby pressed home, and made securely tight below; and so soon as the last set of frames is nearly in its place, clothed wedges are driven in at the corners, where it would be inconvenient to make the clothing or cushion of the receptacle as aforesaid sufficiently full, because the shutting of the door might be thereby impeded, and the door or fourth side of the said filter is drawn home. 12, Fig. 3, represents one of the lower hinges of the door, which last may be hooked on or taken off as required; 12 12 represent the connexion between the lower hinges and the upper hinges or closing hooks, and the said hooks are seen in Fig. 7 as drawn up, or to be drawn up, by the levers 16, 16, 16; and when the whole are so drawn up, the door may be conveniently secured by locking the said levers fast in their respective places, and if need be, made more secure by the wedges 32. The method which I commonly use, by preference, for clearing and washing the said filtering frames, and the coverings thereof, is shewn in Fig. 8, where 24 represents a box, having a chamfrered opening at top, wherein the frame 9 10 may be put, and the lower or listed part will stick tightly therein; and 25 is a cock, which affords steam, for the purpose of blowing out the cloth, or cleaning the filtering material, whereby it becomes more easy to scrape off, and to preserve, when required, the insoluble substance adherent thereto; and part of the steam becoming condensed, does serve to wash and more effectually to clean the said cloth or material, and to facilitate the use of a scraper or brush. 30 denotes a plug, to draw off the condensed steam.

And I do farther declare, that my said invention doth consist of a method of filtering, by exhibiting, within a very moderate space, a very large surface of flexible material;

terial; and that the practice thereof is seen in the machinery or apparatus, and in the said annexed drawings, herein described and shewn, and subject to be varied, according to the several exigencies attendant on the use and application thereof, and in the manipulations expressly set forth, or clearly indicated, as constituting that use and application. And that, with regard to the nature and description of the flexible and permeable material to be used, or the addition of various substances to close or obstruct the pores thereof, or the apportionment of temperature, and agitation or repose, together with sundry other particulars in the art of percolation, the same are well known, and cannot be better set forth than by reference to the experience of any operator of competent skill in work of this or the like description.

In witness whereof, &c.

⁂ Wherever, in these drawings, a number is situated between two converging lines, it signifies, that the point where the two lines would intersect, if produced, is the place referred to by the number.

Specification of the Patent granted to JAMES WALKER, *of Wapping, in the County of Middlesex, Ship Chandler; for a Machine or Vessel for the safe Conveyance of Gunpowder, and for its Preservation from Injury by Damp.*

Dated September 7, 1810.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said James Walker do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained as follows; that is to say: In the annexed drawing, Fig. 1 (Plate II.) represents my said machine or vessel, made of copper, brass, or any other fit material, for the intended purposes; but I give the preference to copper, and of any dimensions that may be required: the form is cylindrical, but may be varied, though not in my opinion with advantage. A B and C D represent stout hoops, or strengthening pieces, soldered, rivetted, or otherwise firmly connected with the vessel, so as to project beyond the extremities thereof, and afford chimes, which serve to defend the heads of the vessel from injury, and afford firm and convenient hold for removing the same. And I do further strengthen the said vessel by one or more other hoops if required, which may be fixed and applied either within or on the outside of the same at the top A B of the said vessel, of which the plan is also shewn in Fig. 2; the head consists of a circular piece, having a large perforation E F, upon which stands the rim, or upright circular piece L L of a larger diameter than the opening E F; and upon and around the said rim L L a cover G H is applied, which may be opened by any joint of the nature of an hinge at H, but I prefer a simple stud or pin standing outward from L, and passing through a hole in the rim of the cover at H; and the said cover has a piece projecting on the side G from its lower edge, in which piece there is a slit of the nature of an hasp, which goes over a staple in the head of the vessel, and affords the means of closing the same by a bolt or pin, or a copper padlock, or other usual means of compleating such fastenings. I represents a thin plate of copper or lead, or zinc, or other flexible metallic substance which fits or nearly fits the internal space within the rim L L, and is used as a first cover by placing it upon the projecting part E F, and securing the joint, if thought fit, by the application of putty or some proper luting or cement in the angle near the circumference thereof; and I do put upon the said piece I a round piece of leather, flannel, or other like material, sufficiently large to extend beyond the rims L L, and I do press into the space K upon the leather, flannel, or other like material, a round flat piece of wood, or a hoop, or ring of copper, brass, or other proper material, which fits that space so nearly as to require a moderate pressure to send them home, after which the cover G H is to be put on, and the whole will be perfectly secure; and farther that when it shall at any time be required to open the said vessel, the same may be effected without any difficulty, or the use of any appropriate tools, namely, by first taking off the cover G H, and in the next place raising the wooden cover by pulling at one side of the leather, flannel, or other like material, or by any other obvious means. And lastly by giving a stroke with a mallet or otherwise upon the metallic plate K, when the putty or cement joint will give way, and the plate may be pulled up.

And, lastly, I do declare that among the numerous advantages with regard to economy, safety, and the facility of use in this my said invention, it is singularly worthy of notice that gunpowder, either in cartridges or loose quill tubes and priming cartridges, may at once be packed in vessels constructed as hereinbefore described, and kept perfectly dry, and in their original state, for any length of time, without ever requiring to be sent on shore, to be dried or taken out of the vessels till wanted for use; that there can be no scattering nor waste; and more especially that all the danger of filling cartridges in the powder rooms of ships of war, and elsewhere, particularly during the time of action, is removed by charging the said vessels at the mills, magazines, or arsenals, with cartridges ready made up, and adapted to the several exigencies of the land and sea service, whether in their actual dimensions or in the quantities to be filled in each cartridge, to adapt the same to artillery when it shall have become heated; and that the quantity of gunpowder, and the numerous tools, implements, hides, and other materials, which will be saved by the use of my said invention, and the diminished expenditure of the cartridges, which will not be exposed to rot, nor to the necessity of being changed or shifted, do form an amount of saving which is immense, and that I do not, in this present specification, enter into any further detail of the said advantages, because the same cannot but become manifest in the use and application of the said machine or vessel.

In witness whereof, &c.

OBSERVATIONS BY THE PATENTEE.

It was represented by the Hon. Wellesley Pole, in the House of Commons, in a debate on the ordnance estimates, in March 1810, that the excess in the consumption of gunpowder was occasioned by the impossibility of keeping it dry at sea; and the same complaint was again urged by the Hon. Ashley Cooper, in April 1811, who also stated that the floating magazines were too damp for the stowage of gunpowder; and Sir William Congreve, Comptroller of the Royal Laboratory, in a statement of facts, dedicated, by permission, on the 10th of April 1811, to the Right Hon. Earl Mulgrave, Master General of the Ordnance, confirms the above, by stating, that the gunpowder in the British service was so inferior to that of the enemy at the conclusion of the American war, that it was the constant subject of complaint, both in the navy and army; and as a fact, that when the fleet was disarmed at the termination of that war, in some of the line-of-battle ships there were not ten barrels of powder fit for service. Since that time the greatest attention has been paid to the manufacture of gunpowder both at the royal powder mills, and by the private powder makers who contract for the supply of government; so that the British gunpowder, when first made, may be ranked with any Foreign powder; but from the impossibility of procuring seasoned wood to make the powder casks, added to the absolute necessity of keeping an immense quantity of powder in the different depôts for the supply of the navy and army, (all of which are situated on the sea or river sides, or in floating magazines, and are consequently much exposed to fogs and damps,) and from the impossibility of preventing the damp from injuring the gunpowder in the wooden barrels, even in its short transit from one magazine to another, or from being speedily damaged in the magazines of the men-of-war, either in those casks or in filled cartridges, notwithstanding every precaution, the gunpowder and the cartridges rapidly go to decay; and the advantages which the service should derive by the superior strength of the Gunpowder made by and for Government, is in a very great degree lessened, if not totally lost to the nation; as Sir William Congreve clearly makes it appear, that between the 1st January 1789 and the 31st August 1810, a period of twenty-one years and eight months,

Government manufactured at their own mills. .... Barrels of Gunpowder	407,408
And purchased of the Gunpowder Makers between 1st March 1794 and 31st August 1810, a period of sixteen years and six months, ... Barrels Gunpowder	241,980
Making the astonishing grand total of barrels	649,388

That

That officer also most distinctly shews, that between 1st January 1785 and 31st August 1810, a period of twenty-five years and eight months, the enormous quantity of powder returned back totally unserviceable, because seasoned wood could not be procured to make the barrels so as to preserve it at sea, amounted to	137,993
And between the 1st July 1790 and the 31st August 1810, the equally amazing quantity returned from the same cause, requiring the process of remaking, by drying, dusting, and mixing old powder with new, amounted to	189,757
Making the astonishing quantity of returned gunpowder (because no means could be devised of preserving it) amount to.... barrels	327,750

Thereby officially proving, beyond the possibility of doubt, that at no part of the above period could it be asserted, as a fact, that any one ship, after being a length of time at sea, was provided with a sufficient quantity of effective gunpowder.

These barrels being calculated to prevent the deterioration of gunpowder, and to preserve its strength as well as the cartridges in all climates and situations, without which no ship can be properly equipped for battle, serious attention to the following remarks, setting forth the vast advantages to be obtained by the adoption of them, is requested.

First. The strength of the gunpowder will be preserved, its ignition will be instantaneous, and its effect will be complete.

Second. The dangerous operation of driving the hoops on and off, or coopering the powder casks, will be done away.

Third. As it is proposed to fill the cartridges on shore ready for action, the dangerous operation of filling on shipboard will be remedied; nor will there be any necessity for shifting the gunpowder into fresh cartridges, which will cause an immense saving, as well in them as in powder.

Fourth. There will be no necessity for sending gunpowder on shore to be dried, at home or abroad, which is a circumstance of the greatest importance, as the service will not thereby be impeded.

Fifth. No more than one barrel need be opened at a time, as the operation is expeditious, and the cartridges can be so arranged in them as to be suited to the length of the action.

Sixth. The barrels are admirably suited to boat service, or to cases of invasion, as the water cannot get into them, although the boats be upset.

Seventh. There can be no scattering or waste of gunpowder, on board ships or elsewhere, which it is evident must produce great safety, as well as great saving.

Eighth. The barrels are constructed to prevent theft, as also the very common and pernicious attacks of vermin, which the present wooden barrels and their attendant articles are ever liable to.

Ninth. In case of a ship taking fire, the magazine may be filled with water, and the gunpowder cannot be injured.

Tenth. They will be particularly useful for the conveyance of combustibles for burning ships, or any purpose that may be required.

Eleventh. The patent barrels, from being cylindrical, contain, with ease, in cartridges, the quantity of gunpowder allowed by act of parliament to be conveyed loose in any package, namely, 100lbs. The wooden barrels sent on board his Majesty's ships are filled with 90lbs. so as to allow the powder to be shook, to prevent its being set or lumpy; but notwithstanding every care, it is ever found to be the case, in consequence of the damp, which the patent barrels entirely exclude.

Twelfth. As the patent barrels contain more gunpowder than the wooden barrels, without occupying a greater space, the quantity required for a seventy-four gun ship will be held in three hundred, in place of three hundred and thirty barrels; so that there will be more spare room in the magazine, and no increased weight to impede the sailing of the ship, and all the following articles will not be required, *viz.* wooden barrels, copper hoops, copper powder measures, copper adzes, copper drivers, copper vices, copper sieves, copper funnels, copper shovels, bouge barrels, and horse hides, which are ever liable to be lost and pilfered, and are most expensive.

Thirteenth. Wooden barrels are a dangerous and useless conveyance for gunpowder; when returned to the magazines, they require repair and coopering: the breakage and loss of copper hoops is very great; and when the barrels are worn out, they are not of the least value: the patent barrels, on the contrary, are a perfectly safe conveyance for gunpowder; they require no repairs, and will last for a great many years.

Fourteenth. As gunpowder, when returned from on board ship in wooden barrels, is valued only at half-price, the saving which will be produced by the adoption of the patent barrels will be immense, as gentlemen of the highest chemical knowledge are of opinion they will keep it dry for any length of time; by which means they will render the drying-houses, and all the attendant expences, unnecessary.

Fifteenth. It is presumed (including all the attendant expences of drying-houses, &c. &c.) that gunpowder made by government costs infinitely more than it does at the private mills; but supposing each barrel of powder was to cost 8*l*. exclusive of copper hoops, sixty thousand barrels, the quantity stated by the Hon. Wellesley Pole to be annually required, would amount to 480,000*l* per annum, one-fourth part of which, at the very lowest, may be annually saved by adopting the patent barrels.

Specification of the Patent granted to THOMAS FIELD SAVORY, *of New Bond-street, in the County of Middlesex, Chemist; for an Invention of the Combination of a natural Salt or Powder, which possesses all the Properties of the Medicinal Spring of Seidlitz, in Germany, under the Name of* The Seidlitz Powders.

Dated August 23, 1815.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Thomas Field Savory do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, is described and ascertained in the following explanation thereof.

The process for making the Seidlitz powders, as invented and sold by me the said Thomas Field Savory, at No. 136, New Bond-street.—Recipe, No. 1. Take of subcarbonate of soda twenty pounds, supertartrate of potash twenty-four pounds (avoirdupoise weight); dissolve the subcarbonate of soda in twenty-five gallons of boiling water, and add the supertartrate of potash; filter the solution through paper, and evaporate it in a gentle heat until a pellicle appears on the surface; then set it by to crystallize; redissolve the crystals thus formed in six times their weight of boiling water: the solution must again be filtered, evaporated, and crystallized, and afterwards reduced to a fine powder.

Recipe, No. 2. Take of subcarbonate of soda one hundred pounds, carbonate of ammonia twenty-five pounds; expose the subcarbonate of soda to a heat sufficiently strong to liquify it; then add the carbonate of ammonia in powder, and with a heat of 212° dry the salt, and pass it through a fine sieve.

Recipe, No. 3. Take of supertartrate of potash one hundred pounds, mix it with thirty pounds of finely powdered chalk, and add it by degrees to one hundred and sixty gallons of boiling water; stir it for some time, and when the tartrate of lime has subsided pour off the supernatent liquor, and wash the residuum repeatedly with cold water. To the tartrate of lime thus formed add thirty pounds of sulphuric acid, previously diluted with eight times its weight of water; stir the mixture frequently during twenty-four hours; and, after having separated the acid from the sulphate of lime, by means of strong pressure, evaporate it in Wedgwood's dishes, over a sand heat, till a pellicle appears on the surface; then set it by to crystallize: these crystals are to be dissolved in boiling water, filtered through white filtering paper, and again crystallized.

Each dose of the Seidlitz powders consists of two scruples of Recipe No. 3, finely powdered, and dissolved in half a pint of spring water; to which are added two drachms of Recipe No. 1, and two scruples of Recipe No. 2 (previously mixed): they must be stirred together, and taken during the state of effervescence.

In witness whereof, &c.

Observations on Wheels of Carriages and Sledges, by Mr. Gompertz, *and communicated by him to the Editors.*

With an Engraving.

In estimating the quantity of force which a carriage wheel loses in overcoming the obstacles in the road, it will not appear to equal that which would be required to draw it up an ascent equal to the sum of their heights, but it depends on the nature of the obstacles, the nature of the force which acts on it, its velocity, and the size of the wheel, which might be so that it should either require a much greater or a much less force, and might even be so that there should not be any force lost by them, notwithstanding the obstacles be of considerable size, or so that the whole force should be lost. I have here selected a number of cases, most of which happen sometimes in roads, at least in some degree.

Case 1.—If a wheel A H, Fig. 3. (Plate II.) which was moving along the road, were to be opposed by a perpendicular obstacle B E, higher than the centre of the wheel, of course it would be stopped by it, however great its velocity might have been, and the whole force would be destroyed; but if the obstacle should not be as high as the centre, the force may be so great as to surmount it, and the loss of force may be found as follows.

Let the wheel A H be considered as moving along the line N E, by a motion which it has already acquired, and not

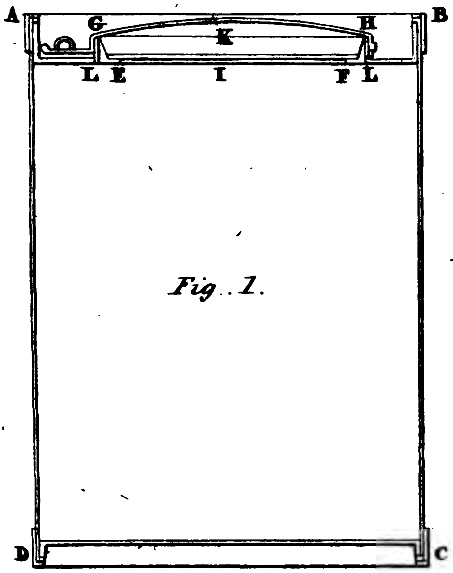


Fig. 1.

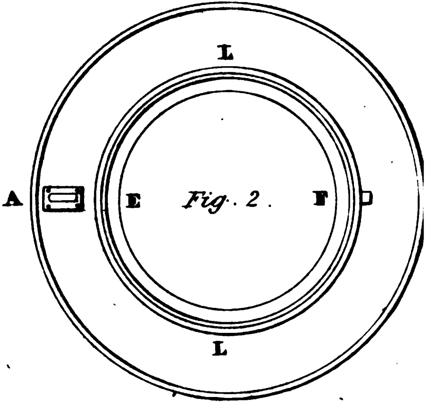


Fig. 2.

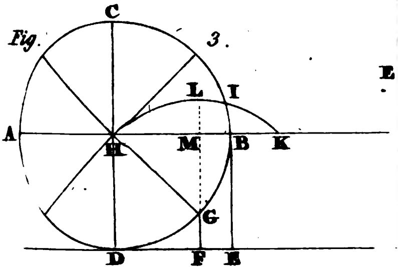
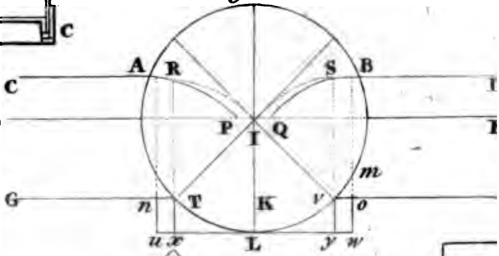


Fig. 3.

Fig. 4.



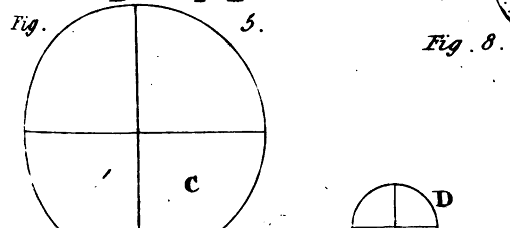


Fig. 5.

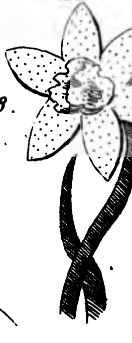


Fig. 8.

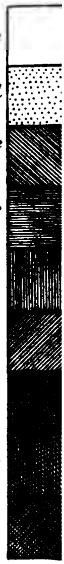


Fig. 9.

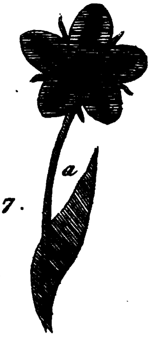


Fig. 7.

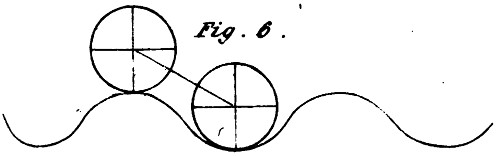


Fig. 6.

not by a force constantly acting on it in the same direction as a horse, &c. Let G F be the obstacle, and let the line G F be continued to L in the figure, then the moment the wheel strikes it, a force will be lost by the blow, and the centre of the wheel, which before was describing a right line, will begin to describe the circle H G K in the same manner, and with the same loss of force, as if the centre were to strike that circle at H, and which is that segment whose centre is the top of the obstacle, and whose radius is the radius of the wheel, and touching both centres G and H. After the wheel has struck the obstacle there will be another force expended in raising the wheel to the top of it, or in raising the centre to the middle, or top of the arc L, which is that point where it will be when the wheel will have risen to the top of the obstacle; this force, or an equal one, will be gained again as the wheel descends, in a similar manner to what it ascended, and when it comes to the ground there will be another force lost by the blow it will come down with; this loss of absolute force, considering that the wheel has lost some of its velocity, will not be so great as in the first instance, it is inferred from this, however, that the loss of force is caused by the two blows and not by the ascent, it is obvious that the higher the obstacle be, the greater will be the blows, and consequently the loss of force, as the angle A H L will thereby become more obtuse. The obstacle G F is not here supposed of any thickness, but the breadth of it will not materially alter the case.

It is also to be noticed that when there are a number of obstacles at no great distance from each other, on very hard ground, and the velocity of the wheel is great, that there is not so much force lost in proportion as when there

is

is only one, because the rapidity will cause the wheel, in striking the first it meets with, to be thrown up higher than the obstacle itself, by which means it will escape some of them entirely, this may often be observed in carriages going fast over the stones.

Still in this case there is much force lost by the continued blows, and the obstacles which are escaped very few, unless the velocity is very great.

Case 2.—If the obstacles and depressions be of such a form that the centre of the wheel shall describe regular curve, or curves which form tangents to each other, then if the wheel be moving with an acquired velocity, and not too fast, there will not be any force lost by them, because there will not be any blows, as in the preceding case, to destroy the motion, and the wheel will gain just as much by the descent as it had lost by the ascent, and if the wheel itself were not circular, but of any other regular curve not containing any concave parts, so as to cause blows, provided it were not sufficiently so as to prevent it from turning, or if it were circular, and the axis were not in the centre, and it were rolled along a straight and horizontal ground, it does not appear to me that in either of these cases there would be any loss of force.

But the velocity might be so great that the wheel would not have time to bear on the curve continually, and would be part of the time in the air, in which case a succession of blows will be produced, and consequently a loss of force, but if the velocity were immense, the proportionate loss would probably be less again, because then the wheel would scarcely sink at all, and the blows would thereby be lessened.

Case 3.—If the wheel should meet with a square depression which is too wide to touch both sides of it at once, then to find the loss of force, suppose A I M, Fig. 4, be the wheel which had been rolling on the line G *n* O H, and the centre having described the line C A, let *n u* L *w o* be the depression, let the line E F be drawn passing through the diameter parallel to the ground, and let the perpendiculars A *n*, R T X, S V Y, and B O, be also drawn as in the figure.

Then as the wheel gets to the bottom of the depression L, the centre will describe part of a circle A P, whose centre is *n*, the same size as the wheel, and wholly contained in the depth that the centre had to fall, and the wheel will lose an equal force by striking against the ground near L, that the centre would do by striking against the line E F, if such a line existed, in the direction A P, then it will lose another force when it begins to rise equal to what the centre would do by striking Q B similarly drawn to P A, and in the direction E Q. If the depression should touch both the sides of the wheel at once, shewn by T X L Y V, the loss of force must be much greater, because the motion will change more abruptly, and the centre will describe one acute angle instead of two obtuse ones; shewn by the dotted lines R T S V; it also appears that there will be more loss of force by a small wheel in passing over such a depression, than by a large wheel, either when both or neither of them should touch both sides of the depression at once, because the motion will also, in this case, be changed more suddenly, or the blows will fall more perpendicularly.

But in estimating the loss of force in wheels when they move over irregular depressions, as well as regular curves, it must be recollected that the velocity might be so great that they should not have time to sink deeply into them; in which case the loss of force will not be so great generally as it would otherwise be.

'Case 4.—There seems to me some cases in which wheels of a certain size will act better than larger ones, and one of them is, when they happen to run on regular curves which will not admit of the large wheel C, Fig. 3, to get to the bottoms, but not preventing the small one D from so doing, as observed by Mr. Edgeworth. Then the large will lose a force something similar to what was described in Case 3, and the small wheel, by continually bearing on the curve, will thereby acquire a more regular motion without being impeded by the blows which must be caused when the large wheel goes on the same road; the large wheel will of course not rise and fall so much, but it will lose a force which the other will not.

In all the foregoing cases the wheels were considered as going with an acquired velocity, which appearing to me the most simple case, I have reasoned on it, and although the same will not exactly apply when it relates to wheels when drawn by horses, &c., still it is necessary to understand it first, and afterwards make such allowances as should be necessary when wheels are drawn by those means, and more particularly as when a carriage is in motion the velocity which it has acquired must be taken into account, as well as the force which the animals are continually exerting on it. The difference of friction also between different cases was not taken into account, but I do not think that in the cases mentioned it will alter them materially.

Case 5.—If a wheel were to be drawn over a road regularly curved by an animal walking, and if the path on which he went were straight, or if the wheel were not circular, but of some other regular curve without concavities, or if it were out of centre, so that by either of these means the centre rises and falls, then it seems there will be a loss of force, first, because the animal will not pull in the same direction as that in which the wheels go, and secondly, because they will go with different velocities when ascending and descending the different parts of the curve, which the animal cannot accommodate himself to so as to act to advantage.

Case 6.—However roads may happen to be curved, a wheel in passing over it must rise and fall accordingly, but it seems obvious to me that the curves might be of such a nature that the middle of the body of a four wheeled carriage should, notwithstanding such curvature, travel in a right line, in which case the hind wheels would be ascending one curve, and the fore wheels descending another at the same time, or *vice versâ*, see Fig. 6, but the curves are drawn at random.

Case 7.—It also appears to me that if a wheel were constructed without a feloe or circumference, and consisting of only three or four spokes, or even if it only consisted of one bar with an axis through the middle of it, that provided there was sufficient friction on the ground to prevent it from slipping, the velocity might be so great as to make it nearly perform the office of a common wheel, because as gravity only acts with a certain force, the bar might turn round before the centre of gravity had time to descend perceptibly, and the opposite end of the bar would be ready to take the support in good time, the motion of it then would be chiefly made in the air, and the ends of the bar only would touch the ground, and that for a very short period; and the greater the velocity was, the more equable would the motion be; it also follows that the smaller the bar is, the less velocity will be required to produce this effect; because the number of revolutions in going over a certain space in a given time, will only increase or decrease in the simple proportion to the size of a bar, but gravity increases and decreases as the squares of the distances. Hence the larger the bar the slower will be the revolutions, and the more will be the fall of the centre.

Case 8.—It is likewise to be particularly observed, that independent of preventing friction, a circular and well centred wheel (at least in all the cases which I have mentioned) neither gains or loses any thing by turning, and the same reasoning applies if it be immoveable on its axis, or if it turn round, as it will raise the load over the impediments just in the same way in both cases, that is, whether the wheel be permitted to revolve, or whether it be chained fast and merely dragged over them, as the centre will describe the same curve in both instances, and the same blows will also be produced.

It may be concluded that all kinds of irregularities in roads greatly impede the motion of wheels, but elevations are generally worse than hollows, because when they are at a good distance from each other, and the velocity is tolerably great, they must all be overcome; but when there are depressions, a moderate velocity will prevent them from sinking to the bottom of them; it also seems to me, independent of friction, that sledges must act better than wheels in most cases, because as they cover more ground at once, and as the ends of them can be turned up as gradually as necessary, they will not sink into the hollows so much, and the elevations will be overcome gradually in proportion to the shape of the ends of the sledge.

I have only here to add, that if curb stones were bevelled off to a thin edge, instead of being nearly perpendicular, it might be the means of preventing many accidents which must always be caused by the wheels of carriages rubbing sideways against them, and thereby producing an immense force to break the wheels.

On the Electrical Telegraph, communicated by Mr. I. R. SHARPE, *of Doe Hill, near Alfreton.*

IN the Repertory of Arts, vol. XXIV. second series, page 188, is an account of an electrical telegraph by M. Soemmering. This account I did not see till a few weeks ago. Without the slightest wish to throw a doubt over the originality of M. Soemmering's invention, I beg leave to mention that an experiment shewing the advantages to be obtained from the application of the certain and rapid motion of the electric principle through an extensive voltaic circuit to the purposes of the ordinary telegraph, was exhibited by me before the Right Hon. the Lords of the Admiralty, in the beginning of February 1813.

On the Colouring of Flowers.

Communicated by Mr. J. PHŒNIX, *of Liverpool.*

With an Engraving.

I FEAR the lovers of botany, like myself, have often experienced considerable difficulty in imagining the colours of a flower, from a description with nothing but the outline, light and shade, before their optics; whilst the price of the same work coloured might be so great as to have removed it from them altogether: any attempt to colour from such description can scarcely succeed, from the want of bounds for the different shades; some of these difficulties I hope the following ideas will partially remove.

In heraldry, the stroke of the engraver gives the tint intended, and that part can be correctly coloured by it, if wished. Now in works on botany, with plates, and not intended to be coloured by the publisher, I would suggest such plan in the engraving of flowers as the rough sketch above, observing, whatever position the flower may be drawn in, the lines indicate their colour horizontally. There will, I think, be no want of variety of colours, for we can express eight different ones by such method, (see Plate II.) where *c* represents argent, white, *d* or, yellow, *e* vert, green, *f* azure, blue, *g* gules, red, *h* purpure, purple, *i* sable, black, *k* tenne, orange, *l* sanguine, murrey; each again admitting of so many modifications; the manner of shewing such modifications should be expressed in the breadth or fineness of the line, as may be observed in the drawing of the Pimpernel (see *a* Plate II.), the dot or indication of yellow to follow the same rule as *b*, the scented Jonquil, according to the supposed shade. Perhaps it would assist those wishing to colour their works, to have a scale of tints and marks for such in the beginning of each work, such as inclosed. (See Plate II.) To those who are unacquainted with the marks used in heraldry it is absolutely necessary; to those who are, it may be useful for referring to.

Description of a valuable six-sheet Mineralogical Map of England and Wales, by Mr. WILLIAM SMITH.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

Fifty Guineas were adjudged to Mr. SMITH *for this Communication.*

MY mineralogical map of England and Wales is on a scale double the size of that required by the Society in their premium offered. It has met with the approbation of many noblemen and scientific characters, who have examined it during its execution.

CERTIFICATES.

I am happy to hear from Mr. Smith that his map is completed, and exhibited to the Society of Arts. Proof sheets of the greater part of it have lain with me six months past; and from a minute inspection of the western counties, with which I am conversant, I can certify its accuracy; and from my personal intimacy with Mr. Smith, I cannot doubt the correctness of those parts which have not yet been submitted to my view. I consider the map, in a national view, as the most important work that ever was given to the public.

BENJAMIN RICHARDSON,
Rector of Farley.

Farley Castle, near Bath,
Feb. 23, 1815.

I am happy to find that the Society of Arts, &c. have turned their attention to a geological survey of England, and that the map of Mr. William Smith is now before them. In the preface to my geological work, entituled

"The Character of Moses established for Veracity, as an Historian recording Events from the Creation to the Deluge," I have fully expressed my opinion of the supereminent ability and knowledge of this artist.

About ten or twelve years since, he permitted me to attend him in all his researches, for six months, round Bath, and I have the satisfaction of bearing testimony to his accuracy of observation. I have carefully examined his map, and in every part of England with which I am acquainted, I find this map perfectly agree with my own observations. The utility of his map is great—it is, indeed, inestimable. This I have displayed at large in the work to which I refer. In publishing his discoveries, he has conferred an obligation on his country, which calls for a suitable return, and I am persuaded that his claim will not be disregarded.

JOSEPH TOWNSEND,
Rector of Pusey.

8, *Francis-street, London,*
May 10, 1815.

Mr. SMITH'S *Observations on his Map.*

As the laudable object of the Society for the Encouragement of Arts, Manufactures, and Commerce, is to reward the industrious, and to call forth those energies of the mind, which have furnished humanity with every thing that is great and good, I may be allowed to enumerate in your pages some of the benefits resulting from that knowledge of the strata, which led me to the completion of the great work for which I have just received the honorary reward.

The Society very wisely foresaw, in offering such a premium, that one of the greatest difficulties in understanding such an extensive branch of Natural History arises from a want of some method of generalising the information, which could not be supplied otherwise than by a map, which in one point of view gives the locality of thousands of specimens.

It will be seen, that the island of Britain abounds with a great variety of substrata, which are the cause of as great a variety of soil. Their successive outlines, represented by the coloured lines in the map, occasion considerable undulation of surface, and a great variety of hill and vale, the outlines of which form the natural divisions in the country, which gave rise to the district names in the map.

The wisdom of Providence is thus beautifully displayed in such an extraordinary arrangement of the materials of the earth, by which water is abundantly produced in some parts; building stone, coal, and iron stone, and a thousand other of its valuable products, in others; and all successively raised to elevated ground for man's convenience and easy attainment.

It is the object of this map, and of the works which will follow it, to place those natural advantages in their clearest light, for the benefit of society, and that the labours of those employed in obtaining them may not be misapplied.

The uses of such a discovery of regularity in the courses and order of the strata, and the facility of tracing them by means of their imbedded organic remains, are numerous, and require only to be named to persons of judgment and discrimination, to prove their value.

What can be of greater importance in human affairs, than a complete knowledge of the soil, which man is under a divine injunction to cultivate and replenish, that he may derive from that labour his daily subsistence?

On this particular province depends not only the acquisition of his own comforts and conveniences, but those of all creatures which have been subjected to his will—hence, surely, too much thought, as well as labour, cannot be bestowed upon the subject.

The culture of land is a primary and honorable occupation of life; and all owners and occupiers of the soil should know the means of increasing and improving its produce, as a property in which the public at large, as well as themselves, are most materially interested.

The wonderful admixture of soils, marls, minerals, and fossil shells, are deposited in the earth for a variety of purposes, many of which are doubtless still unknown; but the present discovery of regularity in the strata, to which fossil shells are now become the Indices, may enable the farmer to choose lands most congenial to his wishes, and usual system of management, and serve also to divide and appropriate the great varieties of soil to different purposes, according to the properties and effects of each stratum.

He will thus know where to search for marl or limestone for manure, where to improve by draining or floating, and how to arrange his operations, so as to render them intelligible to others who may be desirous to try similar experiments on soils of the same strata.

The geologist and philosopher will derive an inexhaustible fund of information from such a methodical arrangement of strata, in which the innumerable, fossilated organic remains are imbedded. These mysterious productions, long collected and preserved in the cabinets of the curious, will become doubly interesting to their possessors and collectors, in the easy and pleasant clues they afford to the knowledge of the strata.

Such simple methods of acquiring useful and important information, may lead to a better knowledge of the various beds of coal and ironstone—the improvement of some of those works, and the extension of others; and it will undoubtedly deter many from the imprudent expenditure of large sums of money in searching for these valuable substances out of the regular course of their strata, where there can be no hopes of finding them.

Ascertaining also, that the metallic veins are confined to a particular part of the country, and found not only in particular strata, but in certain fissures of those strata, may check the delusive mining projects into which many have been too incautiously led—extend the just notions of the practical miner, and excite his curiosity to new and unthought-of discoveries.

The various artists employed in building, from the humble brick-maker to the enlightened architect, are all interested in a method of discovering sand, clay, stone, slate, and other materials, and of selecting with certainty such as are best.

Fullers, founders, glass-makers, and potters, will learn where to obtain earths, sands, and clays, of the qualities best suited to their respective purposes, and sources of supply will probably be opened in plans of which they now entertain no idea.

Chemists, colourmen, vitriol, alum, and salt-makers, will learn how to trace the materials they have occasion for, and will be enabled frequently to obtain at once the different advantages of more convenient situations, smaller expense, and an improved quality.

The canal engineer will be better enabled to choose water-tight strata—to find the most appropriate materials—avoid slippery ground or to remedy the evil—better supplies of water will be obtained for canals, and more of the heavy articles of tonnage, which alone can render them profitable, will be obtained from the strata, intersected or contiguous, or from new subterraneous supplies, which may be opened.

The contractor for such works may, from the same abundant sources of information, form his estimates with more certainty to himself, and more satisfaction to his employers.

A better knowledge of the sites and qualities of the different road materials is now become an object of national importance, and hence the necessity of showing the canals, on a map of the strata, by which any improved supply of these heavy articles may be readily ascertained.

The materials for the construction of ponds, reservoirs, and water for their supply, depend also on a knowledge of the strata; and the superior skill of some workmen employed in their construction, arises from a practical acquirement of such knowledge, which they cannot explain.

The quackery of finding water by the divining rod, or other equally inexplicable mysteries, is completely done away, by a method of tracing the strata which produce the springs; and thus the important art of draining land, and of finding water for dwelling houses, is now reduced to a science dependant on a knowledge of the strata. It was upon this principle the author proceeded, in the important improvements he established for Mr. Coke, the Duke of Bedford, and others, in first draining, and then irrigating their boggy land. The author, though not yet very beneficially employed for himself, has had the satisfaction of seeing thousands of acres drained and variously improved under his direction, on the principles established by the discoveries which will now be speedily published, to accompany the map of strata, and he trusts to a generous public for his reward.

Explanation of Mr. WILLIAM SMITH'S *Map of the Strata.*

The courses of the strata, or the length and breadth of surface occupied by each, as they rise successively from the level of the sea, on the eastern to the western side of the island, are represented by colours.

The edges of the strata, which may all be crossed in a journey from east to west, are called their out crops; and the under-edge of each stratum, being the top of the next, and that being generally the best defined, is represented by the fullest part of each colour.

It is thus readily shown, that the most general course of the strata is from S. W. to N. E. and in some parts nearly north and south, whilst in the southern parts of the kingdom, many of their terminations have a contrary direction.

The colours, though brighter than those they represent, are in some degree assimilated to the colour of each stratum, except the chalk, which being colourless seems best represented by green, as strong colours are necessary, and there being no stratum of equal extent which required that colour.

In some cases where the strata are much alike, as the oxlytes, they are represented by light and dark yellows.

The strong blue colour represents the lias limestone, and the light blue, the blue marl which lies over it.

The light part of the black shade represents generally the strata which contain coal, more or less valuable, several beds of which are too thin for working.

The part most valuable and most worked is shewn by the greatest number of crosses which represent the sites of the collieries, and also by the darker shade.

In this mode of representing the strata by colours, various, insular, or detached parts of the same colour may be observed.

Where these occur upon high ground (which will be known by attending to the ramifications of the rivers) they are intended to represent insular parts of the same stratum; but where they occur in low ground, which seldom happens but by the side of large rivers, they are intended to represent the denudated parts of a stratum, whose regular out crop may be at a considerable distance.

Instances of the latter occur in the green representations of the chalk, in Norfolk and Suffolk; and of the former in the yellow representations of stone-topped hills, in Gloucestershire.

The canals are added to this map for the purpose of shewing how the heavy articles of subterraneous produce may be best conveyed from their native sites in the strata to the places of consumption. It may thus be seen what parts of the kingdom have benefitted most by canals, and where they are still wanting, and from whence the heavy articles of tonnage (which alone can render them profitable) may be the most readily obtained.

On excluding Wasps from Hot-houses.

By Mr. JOHN DICK, *Gardener at Ballendean.*

From the TRANSACTIONS of the CALEDONIAN HORTICULTURAL SOCIETY.

I NOW submit to the Caledonian Horticultural Society, a method, confirmed by actual experience, of keeping wasps out of peach-houses and vineries, where they often destroy both the grapes or peaches. I send you a small model* of a hot-house, covered with a kind of cloth, called scrime, which answers that purpose extremely well: I thought a model, shewing the method of putting it upon the hot-house, would give a clearer idea of the plan than any description would have done.

The cloth is made in the form of a sheet or sail, to answer the dimensions of the house; and is bound round the outsides with a kind of tape like the pattern. Barking it like the fish nets, would be of service. However, it will do, with or without it, as convenience may answer. The cloth is about a yard in width; and is sold at about eight-pence or nine-pence per yard. There is another kind a little different, but higher priced.

When the grapes are beginning to ripen, or the wasps make their appearance, it is time to put on the cloth in the manner shown upon the model, with small tacks; and only in such a way as will let the sashes go up and down: the cloth will not need to come any farther down, than the bottom of the top sashes: that is the reason why I have covered the model with a little rough draught on paper, of two sashes half down and two up. The cloth is so very thin, that it will permit plenty of air to pass, and yet no wasp will attempt to go through. It does not exclude much of the sun, and will not hurt the grapes in the smallest degree.

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* No drawing of the model being given in the Transactions, it cannot be here represented; but from the above account any person with a little ingenuity will be able to effect a similar contrivance.

If the hot-house stand by itself, or in the middle of a *range*, you will see by the cover upon the door of the model, how to prevent them from getting in, when any person is passing from house to house. The cover being fastened at the top of the door with small tacks, as upon the outside roof; and the sides of it, upon small hooked wires, can thus be taken off at one side, when passing out of or into the house: and if the door is wanted to stand open for air at any time, it will answer for the same purpose.

When the house has sashes in front, the cloth may be nailed upon the outside or inside, according as the sashes shift with the hand, or are drawn up and down with a rope, still giving plenty of air when wanted. I have never seen a single wasp attempt to go in by the lops of the glass.

There is at Ballendean, one large vinery, about forty years old, with large panes of glass, and no wasps ever get into it; and there is a large new vinery with the lops of the glass all puttied, and the old vinery is as impenetrable as the new one.

I have seen various ways attempted of keeping the wasps from grapes. I have seen the grapes put in paper bags; but the exclusion of air causes them to damp off. I have seen also gauze bags put upon them, which is still more expensive, and gives a good deal of trouble. But the above method, shewn by the model, gives free air and free access at all times, and preserves the grapes in good order; besides, it is a pleasure for the proprietor to go into the vinery and pull the grapes without molestation from wasps, instead of going into a vinery resembling a hive of bees buzzing about one's ears.

When the fruit is all cut, the cloth should be taken off and well washed, and then kept in a dry place until needed again. If any noblemen or gentlemen try the above recommended method, they will find themselves amply rewarded for their trouble.

If the Caledonian Horticultural Society wishes more information, they may, by desiring any of their members in this neighbourhood, to call at Ballendean, find the truth of the above statements, and get any further information they may wish.

On transplanting large Fruit Trees, whether Wall Trees, Espaliers, or Standards. By Mr. JAMES STEWART, *Gardener to Sir John Hope, Bart. Pinkie.*

From the TRANSACTIONS of the CALEDONIAN HORTICULTURAL SOCIETY.

THE first thing claiming attention, is to prepare proper pits for the reception of the trees. They ought to be of a size sufficient to admit of the roots being spread out at full length, with two feet additional, for encouraging the growth of new roots. If the trees are to be planted in borders which have been previously occupied by other trees, the soil should if possible be renewed, but if that cannot be accomplished, as was the case at Pinkie, a cart-load at least of fresh good soil from some old pasture or ground that has not been in cultivation, (loam, if good, is to be preferred,) with a quantity of well-rotted dung, should be allowed to each tree, mixing the whole well with the old soil.

In transplanting large wall trees, begin with drawing a semicircle, of extent according to the size of the tree:

should the branches cover from 150 to 250 square feet of a wall, it may be eight feet in circumference, measuring from the trunk of the tree each way. Dig a trench round the semicircle three feet wide, and six inches below the roots; be careful in preserving the whole, and work out the earth from amongst them with a blunt three-pronged fork, throwing out the loose mould with the spade. Proceed thus till you have got fully under the tree. The roots should be tied together loosely; the branches carefully loosened from the wall, and tied up in parcels to prevent their being injured. The tree must then be conveyed to the place where it is to be planted. Place it upright in the pit, so as the surface roots may be level with the top of the border. Well-broken earth is then to be packed in underneath and for about a foot round the bottom of the trunk, to fill up all vacuities where roots originate. All the roots are then to be carefully spread out at full length, cutting off those that are dead, bruised, or knotty; the remainder to be cut smooth at the ends, and at different lengths, keeping some at full length, others at five, four, and three feet, and some even at one foot long; taking care to preserve as many of the small fibres attached to the leading roots as possible. Begin first at one side of the semicircle next to the wall, and lay out a set of the bottom roots in a level and fan direction, taking care to spread out the small fibres in regular order; cover this first layer with from two to three inches of mould, packing it well with the hand, then spread another layer above the former, packing and covering as before, and so on till you finish at the top, never attempting to lay more at one time than can be readily reached with the hand; never setting a foot upon the roots that have been covered. In this way proceed with layer after layer until you reach the centre of the semicircle; then begin at the other side, and proceed as before, cover the whole with earth to the height of two inches above the level of the border; and after this lay rotten dung, three inches thick, above all. A good watering should then be given, to settle the earth about the roots. A few boards may be laid at the bottom of the wall, to prevent the roots being trodden upon while nailing up the trees. The principal branches only should be fixed at first, nailing up the whole five or six weeks afterwards, when the border has had time to settle properly.

The only difference in moving espalier and standard trees is, that a full circle is to be dug round them.

The best season for transplanting large trees is from the middle of November to the middle of March. Dry mild weather should be chosen, frost and wet being both very unfavourable to this operation.

Above 160 large trees have been transplanted at Pinkie within the last four years. Only three of these have failed; and some omissions took place in the management of these, otherwise they might also have succeeded. Several of the transplanted trees bore half a crop the first year; and one standard apple above a bushel the second year.

Watering and sprinkling water over the branches of newly-transplanted trees in dry weather is of great benefit.

Pruning is to be attended to when the trees begin to shoot. It must be regulated by the strength of the tree: if the tree be vigorous, little pruning is requisite; if otherwise, the knife may be more freely used.

A Committee of the Society having been appointed to examine the state of the transplanted trees at Pinkie, the following Report was received, and an extra silver medal was awarded to Mr. Stewart for this communication.

"September 1812.

"We were agreeably surprised to see very plentiful crops of fine fruit on the trees in Pinkie garden, which were transplanted when full grown, between four and five years ago, when the scite of the fruit garden was changed. On the wall trees, espaliers, and standards, the crops were equally good. Many of the branches of the standards were quite pendulous with the load of fruit. Numbers of the wall and espalier trees measure from twenty to forty feet between the extremities of the branches, and are quite healthy. The principal kinds of trees transplanted are Jargonelle, Winter Achan, Green Yair, and Carnock pears; and Hawthorndean, Nonpareil, Codling, Ribston Pippin, and Gogar Pippin apples. Mr. Stewart's undertaking was perhaps the greatest of the kind ever attempted in this country: it has been most successful; and it is to be hoped that horticulturists will know how to appreciate so excellent an example.

JAMES SMITH,
PAT. NEILL."

On the Purification, Improvement, and Decoloration, of Wines by Means of Charcoal.

By M. DENYS DE MONTFORT.

From the BIBLIOTHEQUE PHYSICO-ECONOMIQUE.

RED wines converted into white become superior in quality than they were originally. One previous and essential observation is, that the better the quality of the red wine the better will be the white wine produced from it. If it be done in the large way, and a whole pipe is to be operated upon, that is selected which has the most pleasant taste, the most fragrant smell, that is not pungent, and has no taste of the cask; in short, a wine that is sound in every respect. When the pipe is selected the proportion of half a pound* of charcoal powder to a litre (rather more than a quart English) of wine is thrown in by the bung-hole, and briskly stirred; the butt is then carefully stopped; the operation is repeated once every day for a week, in which time the change of colour takes place. It may be left untouched afterwards, without inconvenience, for an indeterminate length of time, because the charcoal, if pure and properly chosen, will communicate no smell nor taste to the wine. The decoloration is often completed by the fourth day.

The change of colour being effected, the wine is drawn out by a cock, or ordinary syphon, and filtered through a large funnel, covered and lined with filtering paper, by placing in the pipe of the funnel a piece of linen rag to support it. The wine comes out quite white, and however high the colour may have been previously, the decoloration is perfect, preserving the same fragrance and taste, and being much improved in quality. When the decoloration is to be effected in the small way, and in bottles, a greater proportion of charcoal powder is used, the vessel is shaken and the liquor filtered after the decoloration. The two operations may even proceed at the same time, the transparency of the bottle serving to shew the degree of limpidity.

To obtain a pale coloured white wine two modifications are requisite, the operation in other respects is the same. These are, first, that the charcoal is not suffered to act long enough to effect a complete decoloration; secondly, that less charcoal is employed. The pink wines are done in the same manner, requiring less time and less charcoal. For Muscadel wine the red wine of the same year is taken, and twice in twenty-four hours a few handfulls of dried elder flowers are infused in it, the quantity is optional; syrup of grapes is then added, in greater or less quantity, according to the strength of the wine and the degree of edulcoration desired. After this the charcoal is put in, the mixture being stirred at the same time, as before directed, then filtered, and the colour is pale or deep, according to the quantity of time and charcoal employed.

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* We apprehend there is some error here as to the proportion of charcoal employed.

The Malaga is made with old and generous wine, into which is put a cup of liquid tar, and some syrup of grapes or melasses; the mixture is agitated by rolling it about for a few days, and the wine is excellent when it has been treated with charcoal like the preceding. Another Spanish wine, dry Malaga, may be obtained by the same operation, except that it does not require either melasses or syrup of grapes.

To obtain wormwood wines, iris of Florence, which smells of the violet and tastes of the raspberry, &c. also the medicinal extracted from vegetables and the aromatic, it is only necessary to add to the wine the vegetables and aroma's that are deemed necessary to edulcorate it suitably, or to leave it dry; to charge it with charcoal, and to filter it the same as in the operations before described; and if, after the operation, the aroma is not sufficiently powerful, a little alcohol may be added, charged with the desired aromatic principle.

Memoir on the State of the new Manufactures in France, especially as relates to Sugar, its Clarification, &c.

By M. le Comte Chaptal, *late Minister of the Interior.*

(Concluded from Vol. XXVIII. Page 383.)

THE boiler into which the cleared juice falls, should be about eight feet long, five and a half wide, and 22 inches deep. As soon as the bottom of this boiler is covered with the liquid, the fire is lighted, and the heat raised to ebullition as quick as possible. The instant the liquor begins to boil, sulphuric acid, diluted with 20 parts of water, is poured into it, in the proportion of a tenth part of the lime employed; the whole must be well stirred, that it may be completely mixed: in order to ascertain that there is no excess of lime or of acid in the liquor, it may be tried upon paper coloured with turnsol or curcuma. It is best to suffer the excess of lime to remain, and to employ no more of the acid, the moment that it gives to the curcuma paper a tint of a pale brick or deep white wine colour. After this operation, three *per cent.* of animal charcoal, well pounded to an impalpable powder, is mixed with the liquor, and immediately afterwards is added half of the charcoal that was used the evening before.

It has been observed that charcoal which comes from the preparation of Prussian blue, produces a better effect than that which proceeds from the distillation of animal matters in the manufactories of sal-ammoniac, which seems to retain the state of extreme division that is effected by the calcination; for it is ascertained that animal charcoal produces a greater effect in proportion as it is more attenuated and divided by pounding. M. Figuier of Montpellier was the first who discovered the superiority of animal charcoal to that of wood for decolouring liquids; and M. Derosne's application of it to the syrup of beet-root, is so much the happier, as this charcoal, besides its property of decolouring, destroys the bad effects of the lime, and gives greater facility to the boiling.

After the last addition of charcoal the liquid is evaporated, till it has acquired the consistence of from 18 to 20 degrees; it is then made to run into a smaller and deeper boiler, and is left at rest till the next day, when the boiling of the syrup is effected.

The Boiling and Refining.

The operation of boiling the syrup is the most delicate of any, but it has been rendered extremely easy by the improvements that have taken place in the preparatory operations, especially since the use of animal charcoal has been introduced. Many manufacturers have failed in boiling the syrup; and that which should be attributed to a bad manipulation, has generally been supposed to be owing sometimes to the non-existence of sugar in the beet, and sometimes to the almost insurmountable difficulty of extracting it. Now, this operation is become so easy that skim rises; it never burns during the boiling, and requires very little more care on the part of the workman who conducts it.

Previous to the boiling, the concentrated juice made the evening before, and which still retains some degree of heat, is filtered through a coarse piece of woollen cloth; it is then poured into a round boiler, two feet in diameter and 18 inches deep, till it is one-third full, and is then heated to ebullition, which is kept up to the end of the operation. If it chance to burn, it is perceived by puffs of white smoke, which come from the bottom of the boiler, and burst through the surface of the liquid, spreading a pungent smell; the fire must be slackened, the liquor stirred, and the operation more carefully attended to. This accident was common three years ago, but by following the aforesaid process it is now become very rare. . If the boiling mass swells, rises, and froths, it may be moderated by putting into it a small piece of butter, or by slackening the fire. The means of judging that the operation is going on well are, first, when it boils *dry* and with noise; second, when the syrup detaches itself from the skimmer without drawing into threads, and without adhesion; third, when on striking the boiling mass with the back of the skimmer, the blow sounds dry, as if it struck upon silk; fourth, when it produces very little skim; fifth, when on taking up some of the froth, or the bubbles out of the boil, with the skimmer, the bubbles disappear directly and resolve into liquid: this latter character distinguishes the bubbles of the boil from those of the skim; lastly, we may be satisfied that the operation has proceeded well, if no traces of black can be perceived at the bottom of the boiler, and the surface appears clean.

The time proper to terminate the boiling of the syrup may be known by the following indications: first, by dipping the skimmer into the syrup, and on taking it out again pass the thumb rapidly over the edge, in order to take up a little of the syrup; work this drop of syrup between the fore finger and thumb, till it has acquired the temperature of the skin; then separate the finger and thumb rapidly: when it does not draw into a thread between the fingers the operation is far from being concluded; when it begins to form a thread the operation is far advanced, and then the experiment must be frequently repeated. The boiling must be discontinued the moment that the thread breaks *dry;* in this case the upper part of the broken thread shrinks towards the fore finger, forming a spiral, and is never entirely lost in the mass that adheres to the finger. As soon as it is ascertained by this *test* that the operation of boiling the syrup is completed, the fire is smothered, and a few minutes afterwards it is poured into the cooler, taking care to pour it high, that it may be mixed with air, for it is observed that this facilitates the crystallization.

Into the vessel called the *cooler* is poured the whole of the successive products obtained by the different boilings completed in one day.

In the evening, when the whole is thus collected in the cooler, the forms which are denominated *bastardes* are filled; the crystallization of the sugar immediately begins, and is almost always complete the next day; so that in 24 or 48 hours after it is put into the forms, these forms may, without inconvenience, be placed upon the pots for the melasses to run out.

A good crystallization is obtained when the surface is dry, the *paste* well grained and not syrupy, and when the surface of the base of the loaf of sugar cracks and is depressed towards the middle, which is known under the technical name of *fountain.*

I pass over several minor particulars of the process, which would be superfluous, as they are well known to all persons who are at all acquainted with the subject; observing, that in order that none of the juice may be lost, the skim, the residuum on the filters, and the settlings of the boilers, are all put into a lever press, to squeeze out what remains in them. It is very important that the juice be operated upon as soon as possible after it is extracted; for if it is suffered to remain for several hours, especially when it is unconcentrated, it undergoes alterations which injure the sugar, render its extraction more difficult, and considerably diminish the quantity.

I shall not dwell long on the process of refining, which is well known and understood; I shall only relate the improvements made in it by those who have been employed in extracting sugar from beet. M. de Rosne was the first who proposed to refine with alcohol, which is a very expeditious method, and the better adapted for the beet root sugars, as it renders unnecessary a number of utensils which are requisite in the old method. To refine with alcohol, the operation must be commenced immediately as the melasses begins to run; for if any time is allowed for the sugar to dry, the melasses which moistens the crystals thickens, and forms a very hard coat upon the surface of the sugar, which the alcohol detaches with great difficulty: accordingly, the moment that the melasses begins to run, the surface of the sugar loaf contained in the *form* is to be scraped, and a litre of alcohol at 36 degrees of commerce, poured by degrees over the whole surface, the little orifice of the *form* being stopped; the base of the *form* is then carefully covered to prevent the evaporation of the alcohol. In two hours the orifice of the form is opened, and the alcohol runs into the pot, charged with a great proportion of the colouring principle; the operation may be repeated with half the quantity of fresh alcohol, and the sugar is then equal in whiteness to the clayed or fine powder sugar. The sugar is then melted and put into the boiler with beef's blood. The operation is terminated by either claying or alcoholising it again; but it has been observed, that the last mentioned gives the sugar a more heavy look than the other, and renders it a little more friable; for this reason I use alcohol for the first operation, and claying for the second. The alcoholised loaves retain the smell of it for some time, which, however, goes off by placing them for a short time in a stove; or even on simple exposure to the open air. It is necessary to employ alcohol concentrated to 36 degrees; when it is weaker it dissolves a portion of sugar. It is not entirely lost, for by distillation it may be freed from the melasses, and employed again as before. Another method of refining has been proposed, which does not appear to me to possess the advantages of the new one just described, or even of the old one: it consists in dissolving 100 parts of raw sugar, and treating it with ten per cent. of charcoal, and ten whites of eggs. When the loaf is in the form, they cause one and a half per cent. of white syrup to run through.

Account of the Expences and Product of a Manufactory of Sugar from Beet.

The process I have described appears to me to be the most certain, economical, and simple of any that have come within my knowledge: and if the price of the sugar produced from it is greater than the sugar of commerce brought from the new world, it is still a new fact in science, and an object of curiosity to society. We shall now give an exact statement of expences and receipts, in order that every one may be able to judge of the importance of this new branch of industry.

The expences are comprised in the price of the beet, the manual labour for the extraction of the sugar, the interest of the sums spent in forming the establishment, the maintenance of the machines, the purchase of fuel, animal charcoal, and other less considerable articles. Beet root is usually sold at ten francs per thousand weight; at this price the cultivator has hitherto met with a reasonable profit, especially when it is raised in suitable soil. By supposing it to be raised in land of a middling quality, but yet good enough to produce corn, we may calculate that an acre of ground will produce a crop of beet at the following expence.

		Francs.
1.	Rent of an Acre	20
2.	Two deep ploughings	24
3.	Two weedings	20
4.	Purchase of grain	3
5.	Weeding and Harrowing	22
6.	Gathering and carriage	40
7.	Manure	50
8.	Impositions	5
	Total	184

We have in this statement charged the whole expence to the beet root, although we have before said that the land appropriated to it was sown with corn towards the 15th of October, after the beet was gathered; and we may therefore charge to the corn the expence of the two ploughings, of the rent, of the taxes, and the manure: it is consequently evident that the amount may be reduced one-third.

We generally estimate the mean product of an acre of beet at 20 thousand weight, which fixes the price for the cultivator at 9 fr. 20c.; but as the cleansing diminishes the beet as much as one-tenth, the 20 thousand weight are reduced to 18, when they come to be operated upon; we shall therefore reckon the price at 10 fr. per thousand to the manufacturer, always supposing that he grows his own beet.

To ascertain the other expences we will suppose that 10 thousand weight of beet roots are operated upon every day.

1. Ten

	Francs.
1. Ten thousand weight of beet roots......	100
2. Two horses and a man................	9
3. Five women to the graters	3
4. Four men to the presses	6
5. Two men to the boilers	3
6. Animal charcoal	10
7. Acid, lime, and beef's blood	2
8. Loss of alcohol, used in the refining	4
9. Fuel	12
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As we suppose the manufactory to be at work only four months in the year, it is proper to assess upon these four months expences of another nature, such as the interest of the money, the repair of the utensils, the salary of the superintending refiner, &c.; thus supposing the establishment to cost 30,000 fr. which is the *maximum* for a consumption of 10 thousand weight of beet per day:—

	Francs.
The Interest of the Money for 120 days amounts to..........................	16
The repair of the utensils and building	10
Salary to the refiner and his man	20
Petty expences	5
Opposite.............	149
Total	200

The expence of each day, therefore, employed in the consumption of 10 thousand weight of beet root is 200 francs.

The produce of this 10 thousand is composed of three distinct parts—the sugar, the residuum or *mare* of the beet, and the melasses. In general the beet furnishes from three to four per cent. of raw sugar, and sometimes even from four to five. The quantity varies according to the state of the weather and the expertness of those who work in the establishment. Supposing only three per cent. is extracted, the 10 thousand weight of beet will then produce 300 lbs. of raw sugar, which, reckoning the daily expence of 200 francs, brings the price of the raw sugar to about 13 sous, or 65 centimes per pound. Besides the produce of the sugar, there is another which deserves consideration; this is the cuttings and the residuum of the beet after the juice is expressed from it. The cuttings, as we have before observed, compose nearly a tenth part of the weight of the beet; they consist of the tops, the radicles, and the earth that adheres to them. On a thousand weight of cuttings, off ten thousand of beet, there is at least a good half which is excellent food for pigs, who are very greedy of it. The residuum or *marc* is a still more important article: supposing 70 per cent. of juice to be extracted, the 10 thousand weight daily consumed furnishes 1500 kilogrammes, or about 30 quintals, of *marc*, which is a very valuable food for horned cattle. This food, which is nearly dry, has none of the inconveniences of herbs or aqueous roots, or of dry fodder; it produces no putrefaction like the first, and does not heat them, or occasion obstructions, like the latter; it contains almost all the nutritive principles of the beet, being deprived of only about sixty per cent. of water, three of sugar, and a little extract and gelatine; oxen, cows, and poultry are very fond of it, and it fattens them better than any other; sheep and milch cows that are fed with it give much more milk, and of an excellent quality. Thus an establishment of the magnitude of the one I am speaking of, may fatten annually from 50 to 60 oxen, or from four to five hundred sheep, with the residuum only.

The melasses is a third product not to be overlooked; a thousand weight of beet will produce nearly 240 pounds, which may be sold at the rate of ten or fifteen francs the quintal, or the fifty kilogrammes; or it may be retained to be fermented and distilled in order to extract the alcohol. When the melasses is kept for distillation, it is diluted with water till the liquor marks from seven to nine degrees; it is then carefully mixed with yeast, or the leaven of barley paste, tempered with warm water, in the proportion of two pounds of the first-mentioned to ten quintals of liquid, and six pounds of the last-mentioned. The vessels that contain the fermenting liquor should be placed in a stove, where the heat is constantly from sixteen to eighteen degrees of the centigrade thermometer; the fermentation soon appears, and is terminated in a few days. The distillation should be effected in the improved alembic of *Adam* and *Bernard*, then the alcohol has no bad taste, and it can be obtained to any desired degree by a single distillation. This alcohol has the peculiarity of being infinitely more pungent than any other at the same degree of concentration. One hundred litres of melasses give nearly 33 litres of alcohol, at 22 degrees. Before the residuum is given to the cattle it may be fermented by diluting it with a sufficient quantity of water, and distilling it afterwards; by this means about four per cent. of alcohol may be extracted from it; but this operation requires a degree of manipulation that induced me to abandon it; nevertheless, it gave rise to an observation that may be useful to be known to persons engaged in the same object. I had conceived the idea of passing water over the residuum, and using it afterwards to temper the melasses; this lessive water marked from two to four degrees; I proceeded afterwards to the fermentation in the usual manner; the fermentation proceeded with facility; when it had terminated I submitted the liquor to distillation, and was surprised to find that it yielded less alcohol, and that towards the end of the operation the liquor expanded or swelled, and passed from the boiler into the worm. I was soon convinced that the melasses had not participated in the fermentation, that it had remained undisturbed, and that only the lessive of the residuum had fermented. This experiment, several times repeated, afforded always the same results; it appears that the melasses mixes without combining with the water of the lessive, which ferments first, and stops the motion of the melasses. The ashes of the *marc* or dregs will furnish nearly one per cent of potash.

General Remarks.

We see by the above relation, that France is able to manufacture, at a low price, as much sugar as is necessary for home consumption. But there are still two or three questions necessary to be examined, in order that nothing may be left undone in a matter of so much importance.

1st. Whether the sugar made from beet root is of the same nature with that of the cane?

2d. What advantages may be derived to agriculture from establishments for the extraction of sugar from beet root?

3d. Whether it is the interest of France to manufacture this sugar?

4th. From what reason have most of the establishments erected for this purpose been given up?

In regard to the first question; *whether the sugar made from beet is of the same nature with that of the cane*, I shall observe, that we are at this time acquainted with three distinct kinds of sugar, all susceptible of yielding alcohol by fermentation, but each differing in particular properties: one is uniformly in a liquid state, another is always a powder incapable of crystallization, and the third is composed of very regular crystals. The first kind, or liquid sugar, exists mostly in vegetables and fruit; it constitutes the syrup when the juice is properly concentrated by evaporation.

The second sort is firm and dry, but without being susceptible of crystallization: the sugar of the grape is of this species, as well as that of honey, and that which is produced from the adulteration of starch by sulphuric acid.

The third kind is susceptible of crystallization; and the crystals take the form of a titraedral prism, terminated by a diedral summit. This species is found in the sugar cane, the beet root, in the sugar maple, the chesnut, water chesnut, &c. This sort is the most esteemed and the most sought for, because it has the pleasantest taste, is sweetest in proportion to the weight, is the most easily used, and is the most agreeable to the sight.

There is now not the least doubt among enlightened men as to the perfect identity of the different sugars that constitute the third sort; and when the sugars are brought, by the process of refining, to the same degree of whiteness and purity, the most experienced can detect no difference in them.

Undoubtedly, when in the first attempts of the manufacture, the sugar produced from beet root was frequently sent into the market burnt, ill prepared, and badly refined, the consumer had reason to reject it, and found it very different from the sugar of Hamburgh or Orleans; but even then the well-informed ranked it in the same species, and attributed the difference to the imperfections of an infant process, rather than to the nature of the principles. Already our celebrated colleague, M. Haüy, had proved that the form of the crystals was the same; already several establishments had exhibited results analogous to those of the colonies; and it was natural to conclude that the same perfection would be gradually attained by all. We know that at all times woollen cloths have been manufactured of the same materials, and that yet the cloths of the tenth century were by no means comparable with those of the eighteenth: we know that every art has its period of infancy, but that in the present age this infancy is of shorter duration, by reason of the progress of knowledge.

That which was predicted has taken place; and in less than two years the manufacture is wonderfully improved; it is simplified to that degree that it is now confided to the workmen, and that there are few operations that afford more certain and uniform results: thus the product of the beet root establishments is circulated in commerce without opposition, and the consumer gives the same price for it as for that of the cane of the same quality. It has been said that this sugar is lighter than the cane sugar, and consequently that the same quantity in bulk does not sweeten so much: trifling as this accusation is, I cannot admit it; I employ the same forms as those used at Orleans, and each furnishes a loaf exactly of the same weight as in the refineries of Orleans.

For three years I have used at my own table no other sugar than that of my own manufactory, and my friends, who had no suspicion of it, have seldom failed to compliment me on the beauty and good quality of this sugar.

I have already observed, that the sugar refined by alcohol exhales, for some time, a disagreeable smell; so that if it is sent to market immediately the consumer will reasonably complain of it; but this is no defect in the sugar, it is the fault of the proprietor, who should not offer it for sale before the smell of the alcohol is gone off. Thus I have shewn that the sugar of beet root and that of the cane, are strictly of the same nature, and that no difference can be found in them.

As to the second question, *whether agriculture can derive any advantage from the establishments for extracting sugar from beet,* I reply, that agriculture must unavoidably derive great advantage from them, for whatever tends to vary the crops, and augment their number, is beneficial to it; in this view therefore the culture of the beet root is advantageous, for besides affording an intermediate crop, it doubles the product of the funds, and does not cause the loss of a single grain of corn. The cultivation of the beet root also renders the soil more light, and clears it of weeds. The manufacture of the sugar is not less useful than the cultivation of the plant. First, the residuum or *marc* of the beet affords food for the horned cattle and pigs of a large farm for the four winter months, November, December, January, and February. Supposing France contains two hundred manufactories, each working upon ten thousand weight of beet root daily, the *marc* or residue of which will fatten from ten to twelve thousand oxen, and from two to three thousand pigs. Second, these manufactories have the advantage of employing the horses and men of a farm during the dead season, and of giving work to others, who, during these four months, would otherwise be condemned to idleness. Independent of the men employed in the cultivation of the plant, the cutting and the extraction of the sugar may employ from five to six thousand persons during the winter, supposing two hundred establishments to be at work.

To the third question, *whether it is the interest of France to multiply these manufactories,* I may answer, that France can have no other interest than that of her inhabitants; consequently, whatever augments the mass of labour, or multiplies the productions of the earth and of industry, and enriches the agriculturist, must merit protection on the part of the government. In this place, the great consideration of the colonies presents itself, and I do not pretend to resolve a question of such high importance; I shall confine myself on this subject to the statement of a few remarks, which I submit to the wisdom of government, and to men more competent to decide than myself. I shall not say, with some writers, that the colonial system does not interest the nation, under the pretext that the colonies bring nothing into the public treasury, that they require the support of a very expensive marine, &c. I know that the colonies open a market for the products of our industry and of our soil, that they supply our manufactories with raw materials, and that they give great activity to commerce. Under all these relations, the colonies have hitherto been one of the principal sources of public prosperity; but if all these advantages can be obtained in the bosom of France itself, if the indigenous fabrication of sugar and indigo can replace the sugar and indigo of the new world, at the same price and of the same quality; if this new branch of industry augments the mass of labour among ourselves, and enriches our agriculture, without depriving us of any of its products, it is evident that there remains against the colonies, without compensation for any superior interests, the annual expence which they occasion, and the numberless chances of war, which all at once sacrifice our fortunes, and force us to privations, when a formidable marine is unable to obtain dominion, or at least equality, upon the seas.

These reasons might be strengthened by looking at the actual state of the colonies, but God forbid that I should pretend to turn the attention of government from an interest equally great to the metropolis, and from its paternal solicitude for the unhappy colonists, who have been despoiled of their property. I only desire, that at the present moment the establishments of indigenous sugar may be encouraged, so that their products, being upon an equal footing with those of the colonies, we may share with foreigners the commercial relations, which are limited to the exchange of our colonial commodities, especially sugar, against the productions of their soil. This becomes the more important, as our principal trade with Hamburgh and the northern countries, consists of colonial commodities, for which we receive wood for building, metal, potash, hemp, flax, and tallow; and that when these great means of exchange happen to fail, England has the advantage of this immense commerce.

The fourth and last question is, *from what cause have the greatest part of the establishments failed that were formed for this purpose?*

Persons who form a superficial judgment of the Arts, are persuaded that the manufactories of sugar from beet cannot support a competition with those of the cane, and they are now confirmed in their opinion by the failure of so many of the establishments that were formed before the peace. To this we might reply, that it is sufficient that some of them still remain, notwithstanding the importation of foreign sugar, to prove that our manufactories are capable of rivalling them; but I prefer in this place to point out the causes of the failure, and to establish certain principles which may serve to guide those persons who may in future undertake to form fresh establishments.

When the extraction of sugar from beet root was at first desired, the government excited the zeal of all France by the encouragement it offered: every where the beet was sown, and numerous establishments were formed, without any previous consideration on the nature of the soil, the expence of the cultivation, or the saccharine quality of the root. Vast buildings were erected at a great expence, graters and presses were bought, the effects of which were not understood; and frequently the whole made ready to set to work, without the least mistrust of the process intended to be followed; and sometimes even unprovided with a man capable of conducting the operations.

The rational progress of a new branch of industry was not attended to, great losses were suffered, and they might have been expected. In some places the beet was found to contain no sugar when it was operated upon; this was the cause of the fall of all the establishments in the south; in others, defective processes were employed, and only syrup could be extracted; and the cultivation or purchase of the beet has cost so much, that the product has not balanced the expence. This inconsiderate mode of proceeding was necessarily the ruin of most of the undertakings; and as every one is apt to reason from his own experience, whether good or bad, a general prejudice soon prevailed against the success of this manufacture. On the other hand, the bad quality of the sugar which some manufacturers sent to market, has contributed, in no small degree, to disgust the consumer.

It would doubtless have been better to have sought out the causes of failure, and to have studied the methods of the prosperous establishments; but public opinion is not always so just, it often adopts a novelty without examination, and still oftener proscribes it without reason. Nevertheless,

theless, the repeated attempts in every part of France have afforded results by which some have profited, and have at length furnished us with a positive knowledge of the culture of the beet root, of its product, and with a certain, easy, and economical method of extracting the sugar from it. Experience has also taught us, that the manufactories of sugar from beet root can only prosper in the hands of proprietors who cultivate the plant themselves, and consume the residue upon their own demesne: indeed, it is only necessary to take a view of the advantages which this manufacture affords, when connected with a large farm, to be convinced of the great difference in the two cases.

First. The proprietor who cultivates the beet, obtains it at a lower price than he who buys it: this difference is immense; especially if we consider, that as it is an intermediate crop, the expence of ploughing and manuring may be laid upon the crop of corn that succeeds it.

Second. The residue of the beet will feed nearly all the horned cattle of a large demesne, during the four severest months of the year; whereas if sold it does not produce half the benefit.

Third. The carriage, and most of the operations, may be executed by the horses and men belonging to the farm; while, in the other case, all these must be paid for this purpose solely, and for a limited time, which increases the disadvantage.

Fourth. Manual labour is dearer in towns than in the country.

Fifth. Fuel is always dearer in towns than in the country, especially wood, which may be employed in some of the operations.

This new branch of industry, therefore, must be established on extensive property, for on such only it can succeed. Independent of the advantages of situation, we may add, that the erections necessarily depending on a large farm will mostly suffice, without any further expence, for the purposes of the new manufacture. I could mention two establishments of this nature, which required no more additional buildings than amounted to the expence of 300 francs. These establishments are in a prosperous state at this moment, and are about to commence their fifth year.

The large proprietor, accustomed hitherto to easy harvests, will probably feel unwilling to undertake this new system, because he may imagine himself not sufficiently acquainted with it; but if he considers that all the expence of experiments has been incurred by others; that the processes we have described are easy and certain; that the calculations, being deduced from experience, are accurate; that the distilleries of grain and potatoes, which are formed in almost all the northern farms, require information equally extensive, without affording so much advantage; since, besides the food for cattle, and the product of the alcohol, which is more abundant from beet root than from grain, we have also the production of the sugar; he will see, that he may at the same time improve his land, and assist to enrich the country with a product which has become one of the first necessity.

Method of preparing different Kinds of Vinegar.

By M. Denys de Montfort.

From the Bibliotheque Physico-Economique.

In all the ensuing operations, it is only vinegar made from red wine that is treated of. The same operation is employed with red vinegar as with red wine, and the same results obtained *; but the decoloration of vinegar is the most speedily effected; it is often ready to filter by the third day. In this operation it becomes as limpid as the clearest water, without losing any thing either in taste or smell of its previous acidity; and in this state it is much superior to the most-esteemed vinegars; it is also the most pure, and the most proper for any purpose that can be desired.

To obtain vinegar of different colours and flavours, the plants, spices, and perfumes with which it is intended to flavour or colour them, are infused in them before the charcoal is applied. If the aroma is not made strong enough, it may be increased by adding a few drops of alcohol charged with aromatic principles of the same nature as the perfumes employed in the first instance.

Vinegar thus prepared is much superior to any that are made with an infusion of any vegetables or aroma's whatever, and it is the best vinegar for the table.

Toilette vinegar is obtained in the same manner as those just described, except that it is filtered a second time, in order to purify and concentrate it still more. It may even be obtained the first time, by an excess of heat.

The lemon, yellow, straw, and golden colours, which are all modifications of yellow, are obtained by employing a small proportion of charcoal for the decoloration.

List of Patents granted in Scotland for Inventions, &c. since April 1, 1814, to January 11, 1816.

RICHARD MACKENZIE BACON and BRYAN DONKIN; for certain improvements in the implements or apparatus employed in printing, whether from types, from blocks, or from plates. Dated May 17, 1814.

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* See the article on wine, page 38.

Thomas Abree Pickering, of Hackney Terrace, Middlesex, Gentleman; for a method or methods of preventing the loss of parcels sent by stage coaches, and for the security of remittances. Dated May 18, 1814.

Charles Howard, of Nottingham-place, St. Mary-le-Bone, Middlesex, Esquire; for certain means of separating insoluble substances from fluid, in which the same are suspended. Dated July 15, 1814.

James Bodmer, of Stoke Newington, Middlesex, Gentleman; for a method of loading fire-arms, cannon, and all ordnance except mortars, at the breech, with a rifled or plain bore; and also a touch-hole for the fire-arms and ordnance; and also a moveable light for fire-arms and ordnance. Dated August 24, 1814.

Joseph Taylor and Peter Taylor, both of Manchester, Lancaster, Machine makers; for certain improvements in a loom to be used in weaving cotton, linen, woollen, worsted, silk, or other cloth, made of any two or more of the said materials. Dated September 14, 1814.

James Dawson, of York-street, Dublin, Esquire; for certain means of producing or communicating motion in or unto bodies, either wholly or in part surrounded by water or air, or either of them, by the re-action of suitable apparatus upon the said water or air, or upon both of them. Dated September 19, 1814.

William Moult, of Bedford-square, Middlesex; for an improved method of acting upon machinery. Dated October 10, 1814.

Grant Preston, of Burr-street, London Dock, Middlesex, Brazier; for a concavious cabin stove. Dated January 7, 1815.

Matthew Bush, of Kesworth, Middlesex, Calico-printer; for improvements in a machine for printing calico cloth. Dated January 21, 1815.

James Thomson, of Primrose-hill, near Clithero, Lancaster, Calico-printer; for certain improvements of printing cloth made of cotton or linen, or both. Dated January 28, 1815.

James Collier, of Grosvenor-street, West Pimlico, Middlesex; for a method or mode of making an apparatus, machine, or instrument, intended to be called a "Criophyrite," whereby a power may be more easily obtained, and conveniently applied, for raising water, and other useful purposes. Dated February 8, 1815.

John Carpenter, of Truro, Cornwall, Esquire; for a knapsack, which prevents the wet coming between it and the back; and a pouch in front, suspended from the shoulder straps of the said knapsack, so as to counteract the weight. Dated February 20, 1814.

William Moult, of Bedford-square, Middlesex; for a mode of evaporation and sublimation. Dated March 3, 1815.

Jonathan Ridgway, of Manchester, Lancaster, Plumber; for a method of casting, and at the same time fixing, metallic types on the surface of metallic cylinders; or metallic rollers, having metallic surfaces; or on blocks having metallic surfaces; or on flat metallic plates, for the purpose of printing patterns on cloth made of cotton, or both. Dated March 13, 1815.

Samuel John Pauly, of Charing Cross, Middlesex, Civil Engineer; and Duos Egg, of the Strand, in the same county, Gun Maker; for their invention of certain aerial conveyances and vessels, by philosophical or chemical, and mechanical means; and which means are also applicable to the propelling of vessels through the water, and carriages, or other conveyances, by land. Dated April 21, 1815.

William Benecke, of Deptford, Kent, Gentleman; for a method of manufacturing verdigris, of the same quality as that known in commerce by the name of French verdigris. Dated May 5, 1815.

James Smith, of Port Seaton, Haddington, Civil Engineer and Salt Worker; for certain improvements in the manufacture of sal amonia. Dated May 17, 1815.

Peter Martineau, junior, of Canonbury House, Islington, Middlesex; and **John Martineau**, junior, of Stamford Hill, in the same county, Gentlemen; for a method or methods of refining and clarifying certain vegetable substances. Dated July 7, 1815.

Joseph C. Dyer, formerly of Boston, in America, now of Manchester, Lancaster, Merchant; for certain additions to, and improvements in, machinery, to be used and applied in manufacturing cards for carding wool, cotton, silk, and tow, and other fibrous materials of the like description. Dated July 17, 1815.

John Cutler, of Great Queen-street, Lincoln's Inn Fields, Middlesex, Founder; for certain improvements applicable to fire-places and stoves. Dated August 1, 1815.

William Bell, of Edinburgh, Clerk to the Signet; for certain improvements in the apparatus for copying manuscripts, or other writings or designs. Dated August 24, 1815.

Thomas Ashmore, Portland Hotel, Portland-street, Middlesex, Esquire; for making leather. Dated September 13, 1815.

Charles Sylvester, of Derby, Derbyshire, Engineer; for various improvements in the texture of bobbin-lace. Dated November 3, 1815.

William Everhard Baron Von **Dornik**, of Sun-street, Bishopsgate-street, London; for an improvement in the manufacture of soap. Dated December 18, 1815.

Robert Cameron, junior, of Edinburgh, Paper-maker; for a machine for manufacturing paper on a principle entirely new. Dated January 10, 1816.

Jean Frederic Marquis of Chabannes, of Russell-place, Middlesex; for a method or methods of extracting from fuel a greater quantity of caloric than hath hitherto been acquired, and applying it to the purpose of warming the room in which the operation is conducted, and also other rooms, by one single fire; and of conducting the air and regulating the temperature in houses and other buildings; and warming and cooling either air or liquids in a much more expeditious, and consequently less expensive manner than hath hitherto been done in Scotland; which method or methods are applicable to various useful purposes. Dated January 11, 1816.

James Lee, of Old Ford, Middlesex, Gentleman; for certain improvements in the methods before invented by him of preparing hemp and flax for their various uses; and by which also other vegetable substances may be rendered applicable to many of the purposes to which hemp and flax are used. Dated January 11, 1816.

John Wood, junior, of Bradford, Yorkshire, Worsted-spinner, and **Joshua Wordsworth**, of Holbech, in the same county, Machine Maker; for certain improvements in machines, applicable to every description of spinning. Dated January 11, 1816.

George Frederic Muntz, of Birmingham, Warwick, Roller of Metals; for a method of abating, or nearly destroying, smoke, and of obtaining a valuable product from such smoke. Dated January 11, 1816.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. CLXX. SECOND SERIES. July 1816.

Specification of the Patent granted to Stephen Price, *of Stroud, in the County of Gloucester, Engineer; for an improved Machine for shearing or cropping Woollen or other Cloths that may require such a Process.*

Dated August 12, 1815.

With a Plate.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said Stephen Price do hereby declare that my said machine acts in manner following. It shears or crops the cloth in the direction of the length of the piece, beginning at one end and continuing regularly to the other. For this purpose the cloth is conducted through the machine by the motion of rollers, and is drawn over a bed or support which lies beneath the stationary or fixed blade of the shears or cropper, [which answers to what is called the ledger blade in the common shears,] so that the cloth passes between the said bed and the said stationary blade. The moving blade of the shears is fixed on the circumference of a cylinder, situated above the said fixed blade, and revolving upon an axis, so that the edge of the moving blade is carried against the edge of the

the fixed blade, and cuts away all the wool of the cloth which rises above the edge of the fixed blade. Several moving blades are fixed upon the same cylinder, to act in succession against the fixed blade; and the said moving blades are placed obliquely to the axis of the cylinder, or in such manner as to form a portion of a spiral, whilst at the same time every portion of the said edge being equi-distant from the said axis, it is manifest that in the revolution of the said cylinder, every part of the said edge will be brought in succession into contact with the fixed blade, thus cropping off in its revolution all the wool, which, by the progression of the cloth over its bed, is brought against the fixed edge. By the time that the revolving edge has been in contact with the whole length of the fixed edge, and is ready to quit the latter, sooner or later, according to the number of edges revolving with the cylinder, the revolving edge next in succession is brought into action; and in like manner the rest in succession are brought into action, and the whole continued are in action * as long as may be wanted. The cloth is stretched in width by what I call stretching bands, which I shall hereafter describe; and the bed or support on which the cloth is cut can be adapted in length to the breadth of the piece of cloth between the lists or forrels, so that the cloth only will be supported or borne up to the edge of the fixed blade, whilst the lists, being depressed below the level of the bed by guards, will escape the action of cropping.

Having now described the action of my machine, I shall proceed to an explanation of its construction.

In the drawing No. 1, Fig. 1, (Plate III.) hereunto annexed, A A is the cylinder, with six blades, or any convenient number, fixed upon its circumference. a a, Fig. 1, shew that the edges thereof are placed at such a

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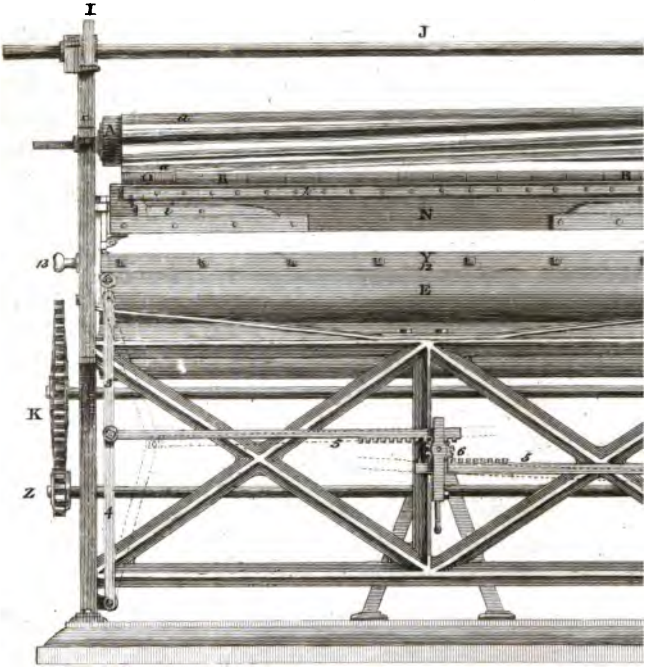
* Compared with the record in the office.

degree of obliquity to the axis of the cylinder that at the same instant that the end of one ceases to cut against the edge of the fixed blade, the following blade will begin its action at the other end of the cylinder. The fixed blade, which cannot be seen in Fig. 1, is situated horizontally, with its edge parallel to the axis of the cylinder, and in a line beneath the centre thereof. (See R, Fig. 5.) The cloth passes immediately beneath its edge, being supported upon the bed B B. The red line in Fig. 2, shews the passage of the cloth through the machine. The cloth is first wound upon a large roller D, from which it passes upwards, and over the inclined feeding table, where it is properly extended in width by means of the stretching bands, so as to take out all creases. After passing under the fixed blade, and being shorn, the cloth descends, and goes between a pair of drawing rollers E and F, whereof the upper is turned slowly round by a train of wheel-work to draw the cloth, which is afterwards gathered upon the roller G, which is made exactly the same as the roller D, so that when the whole piece has passed through and is wound upon G, the latter can be made to change places with D, and the cloth will be ready to go again through the machine. The lower drawing roller F is made to press against the upper roller E, being supported on a lever *r*, adjustable by a screw, to hold the cloth tight between the two rollers, or the rollers may be covered with some substance, to prevent the cloth from slipping, such as plush or fish skin. The train of wheel-work which turns the roller E, consists of a wheel H, worked by a pinion *h*. On the axis of the latter is a wheel K, turned by a pinion *z*, which at the opposite end of its axis has a wheel L, turned by a strap from wheel M, on the end of the axis of the cylinder A A. The wheels L M have different rims, for the band to give different motions, and draw the cloth quicker or slower through the machine. The gathering roller G is turned by a wheel *b*, upon the end of it rubbing against a wheel *y*, on the end of the roll E, and communicating just as much force as will gather the cloth on the roller G, and for this purpose the roll G must be pushed towards E, by the action of a weight or spring. There is likewise a lever, which bears upon the edge of the wheel *b* of the roller D, to cause such a degree of friction as will make the cloth draw tight over the feeding table.

The drawing No. 2 exhibits the parts of the machine.

Fig. 3 shews the stretching bands for extending the cloth on the feeding table to its full breadth. *d d* is an iron frame, secured to the frame of the machine, and supporting the feeding table. Across this frame are two endless straps or bands *m m*, each extended between small wheels *n n*, shewn in Figs. 2 and 5. (One of these is shewn separately in Fig. 6.) The bands have sharp projecting pins fixed in them, to receive the lists at the edges of the cloth. The bands are carried round over their wheels by the motion of the cloth through the machine. The bands respectively travel in a direction rather oblique to this motion, as shewn in Fig. 3, and being confined sideways in grooves in their frames, they extend the cloth in width, because where the bands are nearest together the lists are stuck on the pins; but as the bands proceed diverging from each other, the cloth is extended in proportion to their obliquity, which can be varied as may be found necessary; the frames containing the wheels *n n* of the endless straps being fixed by a screw *e e* through each. In order to adapt the distance between the two extending bands to the width of the cloth, the said screws *e e* are fixed into slides T T, which, by means of a screw V, cut right handed at one end, and left handed at the other, cause the sliders T T, and the two stretching bands, to advance, or to recede mutually from each other; the feeding table may be fixed in any convenient manner to the iron frame *d d*, between the two stretching bands, and on a level with them, so that the cloth will be drawn regularly over it by the motion. To the upper extremity of the frames containing the band wheels *n n*, thin pieces of plate *f*, called guards, are fixed, and project forwards, so as to turn down upon the lists of the cloth, and depress them so low that they will escape the action of the shearing; but to allow this depression, a portion O, Fig. 1, of each end of the bed B is capable of being let down, so that the lists will not be borne up to the edge of the fixed blade; this is explained in figures 4 and 5. Fig. 5, being a transverse section, and Fig. 4 a longitudinal section of one end; B, Fig. 4, represents the same part of the bed as it is marked by B in Fig. 1; it is formed of metal, and screwed in pieces to a cheek or bar P, Fig. 5; each end O of the bed is formed by a number of narrow thin pieces or plates called sinkers, contained between the cheek P, Fig. 5, and another cheek N, as it were, in a trough, out of which they can be raised up to form a continuation of the bed B, or into which they may be suffered to sink down, as shewn towards the end, and thus allow the lists to be depressed: they are borne up by the sliding piece *g* at each end, sliding horizontally in the said trough, formed between N and P, so that it can be brought beneath any number, the end of *g* being made of a wedge form to slide under and raise them up. Each of these sliding pieces *g* has a pin which passes through a slit in the front cheek N, and connects with the sliding pieces *i i*, Fig. 1, on the front side of the bed cheek N. The last mentioned sliding pieces have each a notch to receive a piece *x*, which projects at right angles from the list guards *f*, as shewn in Fig. *5*; by this means the length of the elevated part of the bed is adjusted to the same width to which the stretching bands extend the cloth; and if this width is altered by turning the screw V, the same alteration takes place in the length of the elevated part of the bed. The sliding pieces *g*, which raise up the sinkers, are each contained in a kind of trough or socket *v v*, in which it slides horizontally. The socket *v v* is fixed to the inside between the two cheeks N and P, being screwed to the cheek P: this method affords means to bring the tops of the sinkers to a correspondence with the fixed blade, by elevating or depressing one or both ends of the socket *v*, and sliding pieces *g*, the holes through which the screws pass being made oblong for that purpose. To render the bed somewhat elastic, several thicknesses of flannel or cloth are covered over it, being fastened in front to the cheek N under a plate K, Figs. 1 and *5*; and on the other side of the bed the covering is attached to a plate *s*, Fig. *5*, which is bound down to draw the covering tight, but can be immediately released and turned up, if it is required, to examine the bed R. Fig. *5*, is a transverse section of the fixed blade, and Fig. 7, a plan of the fixed blade, shewing how its edge is presented to the bed, and to the blades *a* of the cylinder A; it is held down by clamp pieces and screws 1, upon a hollow bar *s*, which extends from side to side of the machine; this bar is attached to the frame of the machine by a hinge *p*, Figs. 2 and 5, at each end, on which the whole can be turned up to sharpen the edge of the blade R; but when put down horizontal, as in Fig. *5*, it is retained by bolts *l l*, Fig. 7, which being turned sideways by their projecting handles, catch under a cross bar of the frame, as shewn in Fig. 2. On the front side of the bed is another hollow bar W, Fig. *5*, and to this small pieces of metal *w* are clamped, as shewn in Fig. 8, which spring downwards upon the cloth (see Fig. 5), and hold it gently down upon the bed before it comes to the fixed blade. This bar is fixed with hinges, and both in the same manner as the bar S. The section, Fig. 5, also shews that the moving blades *a* are fixed to the cylinder A, between clamps held fast by screws as represented, which admit of regulating the blades so as they will all cut properly against the fixed blade, when the cylinder revolves in the direction of the arrow. The blades of the cylinder may be placed at a greater degree of obliquity than expressed in the drawing, if found requisite; thus the end of one moving blade may be made to quit the fixed blade at the time when the succeeding blade is in contact at half the length of the fixed blade, and another third blade is just beginning to touch the fixed blade at the opposite end. In this way two blades will always be in action against the fixed blade at the same time. Before the bars S or W can be turned up on their hinges *p*, the cylinder and its bearings must be raised up out of the way by means of the racks I, Fig. 2, each of which racks is worked by a pinion of two leaves fixed upon a common axis *j*, which being turned by a handle at the end, elevates the cylinder and exposes the lower blade and springs *w*. The bearings of the cylinder come down to rest upon the points of screws 14, Fig. 2, by which they can be regulated to make the revolving blades act against the lower blade. In order to introduce the end of the piece of cloth into the machine, the bed B, with its cheeks N and P, can be lowered down from its position. For this purpose the end pieces X, which unite the cheeks, are fitted into the frame of the machine between projections, which form dove-tail grooves, and admit of a vertical motion; this motion is produced by rods 3, jointed to each of the sliders X, and also to levers 4, which move on a centre pin at the bottom part of the machine. From the upper end of the levers 4, two rods 5, Fig. 1, proceed, and being racked engage the teeth of a pinion 6. The axis of this pinion has a handle 7, Fig. 2, which is detained by a spring catch; but when this is released, and the handle turned, it draws the levers 4 from their vertical position into the direction of the dotted lines, Fig. 1, which causes the sliders to descend both together, and to lower down the bed B; when restored to the position in the drawing the levers 4 are upright, and form a firm support to the bed. The levers *r*, which support the lower drawing roller F, are suspended by rods from the sliders X; and therefore when they descend they let down the lower roller F at the same time, so that the cloth can be passed between the rollers E and F. The bed can be adjusted to a parrallelism with the fixed blade R, by elevating either end at pleasure by means of nuts 8, the screws of which are formed on the lower ends of pieces Z; these are fitted between pieces which project from the slides X, and allow the pieces Z to rise and fall independent thereof. The pieces Z support the bed by a pivot 10 at each end of the bed, and by means of two screws 9 9, the bed can be inclined upon the pivot, and thus cause the upper or most elevated part over which the cutting is performed, to approach or recede at pleasure from the edge of the fixed blade R; there is likewise another adjustment for the height of the bed. The nuts 8 take their bearing upon a bar *y*, extended across the machine; beneath this is another bar 12, which is fixed to the two sliders X, and a wedge, 11, is interposed between *y* and 12 at each end; the wedges being connected together by a plate of metal, can be moved end ways by the screw 13, Fig. 1; therefore this moves the

FIG. 1.



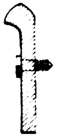
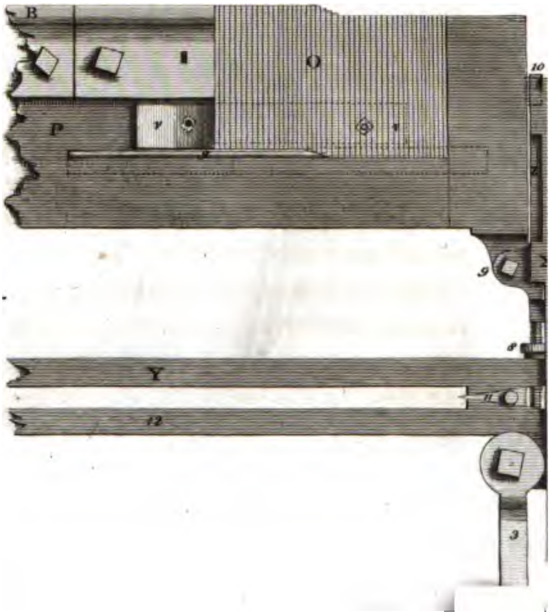
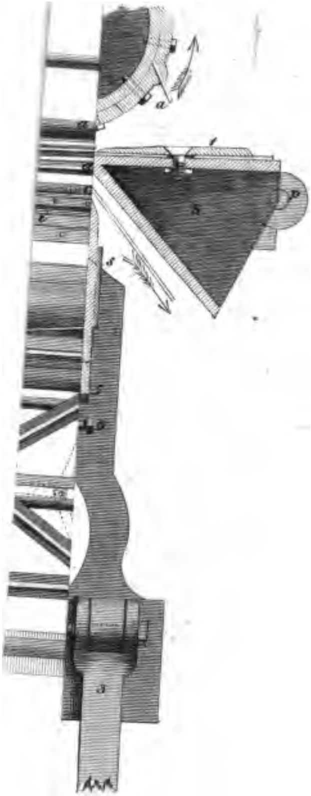
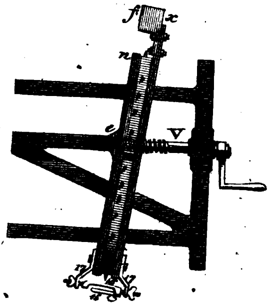


FIG. 4.







Inches

the wedges, and elevates or depresses the bed a small quantity, but equally at each end; this adjustment is used when a thicker or thinner piece of cloth is to be cut, being more convenient than turning the nuts 8, because it cannot put the bed out of parellelism. Two small guides, 15, may be added to the feeding apparatus, for the purpose of conducting the lists of the cloth in a regular manner to the endless stretching bands, and make the lists catch themselves upon the pins. The guides are formed of small pieces of metal, 15, Figs. 2, 3, and 6, fixed to the frames which contain the wheels *n n* of the stretching bands, and descending below the ends of the said frames, as shewn in Fig 6; each of these has a piece, 16, fixed opposite to it, so as to leave a narrow opening between them, through which the lists of the cloth pass, and are thus held down against the bands *m m*, so that their pins must penetrate the lists. The position of these guides, 16, is such, that they will gather the cloth a little in breadth by receiving the lists, and bringing them rather nearer together than the full breadth of the cloth; thus delivering the lists in the most favorable situation to be caught upon the pins of the stretching bands when they are at the least distance from each other. The breadth of the opening between 15 and 16 is adjustable by a screw to the thickness of the lists, so that it cannot come through the opening doubled; but the list will be spread flat and fair to lead upon the pins. The guides are each fixed to the frames by means of two small brackets, 17, through which the ends of piece 15 pass, and are fitted with nuts by which the guide may be drawn to the right or left, to regulate it according to the breadth of the lists.

Having now described my said improved machine, I do hereby declare, that the particulars which I claim an exclusive right to use in machines for shearing cloth are as follows. First, in the method of construction employed in making the bed or support on which the cloth is shorn, so as to be adjustible to different breadths by means of the sinking pieces O, and the sliding pieces *g* under them, at the ends of the said bed or support. Secondly, the whole contrivance and construction of the stretching bands and feeding table. Thirdly, so connecting the apparatus of the stretching bands and feeding table with the movements of the sinking pieces O, that the action of both may be coincident as above described. Fourthly, in the row of pieces of metal *w*, acting as springs, Figs. 8 and 5, which press the cloth gently down upon the bed before it arrives at the fixed blade to be shorn, by which I am enabled to bring the cloth with safety nearer to a level with the upper surface of the fixed blade, so as to shear it closer than could otherwise be done without endangering the cloth. Fifthly, in the arrangements of the parts of the machine, as described and as shewn in the drawings, and in the means for adjusting the different parts to the best positions for working. On this however I must remark, that these may be modified in various ways, at the option of the mechanic, without destroying their efficacy, my object having been to give such a description of these arrangements as may enable any competent workman to construct such an organised machine as shall possess the properties which I have described and exemplified.

In witness whereof, &c.

N. B. Fig. 1 is a front view of the machine, the feeding table being removed; Fig. 2, end view; Fig. 4, section of the bed at one end, half size; Fig. 5, cross section of the bed, half size; Figs. 1, 2, and 3 are drawn to the scale.

Specification of the Patent granted to JOHN EDWARDS, *of Canterbury Buildings, Lambeth, in the County of Surrey, Gentleman; for a Method or Means of preventing Leakage in Ships' Boats and other Vessels.*

Dated August 15, 1815.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said John Edwards do hereby declare that the nature of my said invention, and in what manner the same is to be performed, are particularly described and ascertained in manner following; that is to say: First, lay strips of coarse brown paper, or canvas, soaked in tar or in water, proof cement, made of glue and linseed oil boiled together; lay these over the seams in the inside; then lay battens or narrow planks of wood, of about four inches broad, and about one inch, or one inch and a half, thick, over the seams also, and nail them tight down with ragged nails; indeed, if the planks in the inside of the ship were to be fastened to the timbers with ragged bolts, instead of treenails, this method would prevent any force of water that might be between the outside and inside of the ship, from floating the inside planks from off the timber; this method would not only prevent leakage, but by being so firmly combined together, it is more than probable that it would prevent a ship going to pieces when stranded; though, in this case, it is probable that the outside of the ship would receive damage, but is not very probable, in this case, that the inside would receive any damage; this being admitted, it must be also, that the ship, cargo, crew, and passengers might be saved; however, should this method be objected to on account of rat holes, the patent right embraces another method; that is,

the

the inside of a ship might be lined with any sheet metal, such as copper, iron, lead, &c. in the following manner: nail the sheets of metal close, edge to edge, or edge over edge, and solder the seams; this method will effectually prevent rats from materially injuring the ship: in this case also the patentee recommends the fastening the inside planks to the timbers with ragged bolts.

In witness whereof, &c.

Specification of the Patent granted to EMERSON DOWSON, *of Welbeck-street, in the County of Middlesex, Ironmonger; and* JOHN ISAAC HAWKINS, *of Titchfield-street, in the same County, Engineer; for an Improvement or Addition to Grates and Stoves; and an Instrument, Machine, or Apparatus for supplying Grates and Stoves with Fuel.* Dated 23d March, 1816.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said John Isaac Hawkins do hereby declare, that the nature of our said invention, and the manner in which the same is to be performed, is fully described and ascertained as follows: that is to say; The general intention of our said improvement on grates and stoves, and our said instrument, machine, or apparatus for supplying grates and stoves with fuel, is to produce a more perfect combustion of the fuel than is effected in the grates and stoves of the usual construction: and we do accomplish this our intention by the inserting or depositing of fresh coals, or unburnt fuel, into or under the bottom of a fire previously lighted and burning; and we do prepare our grate or stove for the reception of the said fresh coals or unburnt fuel, by making the bottom bars or gratings, which support the burning fuel, quite flat and level; and we do place under the said bars or gratings, a plate for the purpose of occasionally obstructing the passage of fine coals or cinders between the said bars or gratings; and this plate we do cause to slide away, or otherwise to be hung with hinges, and fall away whenever it may be thought necessary for the admission of fresh air, up through between the said bars to the bottom of the burning fuel; and we do sometimes place upon this plate ribs projecting upwards, so as to fill the interstices or spaces between the said bars or gratings, and present a plain surface to the bottom of the fire; this sliding or falling plate may always be removed after fresh coals have been deposited under the fire, as soon as the heat shall have caused the coals to have a small degree of adhesion: and in stove grates or kitchen ranges we do sometimes make the lowest front bar, or that front bar which is immediately above the horizontal grating that supports the fuel, to slide up, or to turn upon hinges, in order at pleasure to give more room than is usual between the said gratings and the said lowest front bar, for the reception of our instrument, machine, or apparatus as hereinafter described; and we do insert or deposit fresh coals or unburnt fuel under the fire upon the said flat grating and plate, by means of our said instrument, machine, or apparatus, which may with propriety be called a feeding shovel; the construction of this feeding shovel will be easily comprehended by supposing a common fire shovel to have a side perpendicular to and standing up at right angles from the pan or bottom of the shovel, and crossing also at right angles the place where the handle is joined to the pan; let the height of this side be two inches from the bottom of the pan, and let the width of the pan, and the length of the side, be eight inches from the extreme;

extreme ends of this first or handle side, and standing at right angles to the said side; and to the pan let two parallel sides extend to that end of the pan which is opposite to the handle; and supposing the pan to be nine inches long, these parallel sides will also be nine inches long at the bottom edge, where they join the pan; but they are only to be seven inches long at the top edge, and consequently the ends or extreme edges of these sides, next the end of the pan, will taper off in an angle of forty-five degrees from the plane of the pan; let a top piece be seven inches long and eight inches wide, reckoning that direction to be the length which is parallel to the handle of the shovel; let this top piece be united to the three sides above described, which will, together with the bottom or pan, form a box, open only at the side or end which is opposite to the handle, the plane of the opening making an angle of forty-five degrees with the planes of the top and bottom; let this open end of the box be closed by a door, or flap, fastened by hinges to the end of the top piece; let the handle be hollow, and let a rod slide through the hollow handle, and through the end of the box next to the handle; and let a septum or piston, nearly filling the width and height of the box, be fixed at right angles across the end, so that the motion of the said rod forward and backward within the handle shall remove the piston or septum forward and backward within the box; and on being pressed against the aforesaid door or flap, the said piston shall force open the door or flap: the other end of the piston rod may be terminated by a knob or ball, which knob or ball may form a stop, to prevent the piston from being protruded farther through the door way than is necessary for opening the door: the whole motion of the piston may be about eight inches, or from the handle end of the box to about the middle of the door, which is one inch beyond the hinges of the door, or one inch short of the extreme end of the bottom or pan. From this description it will be seen by any competent workman that our feeding shovel consists of a box or scuttle, with a hollow handle at one end, and a door or flap at the opposite end; this door making an angle of about forty-five degrees with the bottom, and one hundred and thirty-five degrees with the top, of the box; all the other angles being right ones, the box containing a piston, made to slide by means of a piston rod moving through the handle: the above measurements are merely given to assist the mind in comprehending the description, for it is obvious that the dimensions of the instrument must depend upon the size of the grate or stove in which it is intended to be used. For large furnace fires, such as are used in steam engines, in distilleries, breweries, or other works where large grates or stoves are used, the feeding shovel may very conveniently be made to hold a peck of coals; but for a small parlour fire, one holding a pound or two of coals will be sufficient. To bring the feeding shovel into action, draw back the piston close to the handle end of the box; open the door and fill the box with coals; shut the door and pass the box with its contents into the stove upon the horizontal grating above described; the door of the box, acting as a wedge, will then lift up the greater part of the fuel previously placed and burning in the stove; then by pushing the piston rod, the piston will press against the coals in the box, and cause the coals to force open the door, and lift up the remainder of the burning fuel; then by continuing the pressure against the piston rod, and withdrawing the box, the whole of its contents will be deposited upon the grating, and underneath the burning fuel. A fire thus supplied with fuel scarcely ever requires any other stirring than what it receives from the action of the shovel at the time fresh coals are inserted. The form of our feeding shovel may be varied at pleasure; as, for instance, the piston may slide outside of the handle, or there may be an opening at the end of the box next to the handle, for the reception of a detached piston; or the door or the top piece may be omitted, in which case the coals might be pushed in under the fire, by means of a detached piston; but though we mention these as possible variations, we do not recommend them, because we give the preference to the form above described, of the piston rod sliding through a hollow handle, and moving the piston in a box having a door, which, when shut down, shall enter as a wedge under the fire. And we do distinguish this our invention from all others which may seem to be similar, by declaring our said invention to be an instrument, machine, or apparatus furnished with a piston, made or used for the purpose of conveying, inserting, or depositing of fresh coals or unburnt fuel into or under the bottom of a fire, previously burning in a grate or stove, formed for the occasional reception of the said instrument, when filled with fuel, as hereinbefore particularly described and set forth..

In witness whereof, &c.

Specification of the Patent granted to ROBERT DICKINSON, *of Great Queen-street, in the County of Middlesex, Esquire; for certain Improvements in the Art of Saddlery.*

Dated November 8, 1815.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Robert Dickinson do hereby declare, that the nature of my invention, and the manner of performing the same, are particularly described and ascertained as follows: that is to say; I do make a pannel or cloth of strong, fit, and suitable material, to be placed on the back of a horse or other animal intended to be saddled; and I do fasten or fix a girth or girths thereunto, having the outer ends thereof provided with buckles, or other proper fastenings, to be attached or fixed to the saddle when in use: and moreover, I do fasten, by sewing or otherwise, in or upon the said pannel or cloth, one or more flat pieces of iron, or other metal, proper for the purpose hereinafter indicated, having the lower face or faces thereof intended to be applied nearest the animal, even, or of such figure as may admit of being so placed without annoying the animal, and having the outer or upper faces thereof jagged, toothed, or studded with points or prominences, in such manner as that the said jagged or toothed parts, or points, or prominences, may lean or be inclined towards the tail or hinder part of the horse or other animal, in an angle of about forty-five degrees, or more or less; and I do call or denominate the said pieces porcupines or porcupine pieces; or otherwise I do fasten upon the said pannel or cloth one or more hooks, standing up and having the concavity of each towards the tail or hinder part of the horse or other animal; and in saddling the same, I do place the saddle upon the porcupine pieces, or immediately behind the hook or hooks of the said pannel or cloth, which is first to be placed upon the horse or other animal, as aforesaid; and I do girth the saddle firmly upon the same by means of the several parts or portions of the girth, which may be passed on each side beneath the chest of the horse or other animal, from the said pannel or cloth to the opposite side of the saddle, and there fastened by buckle or otherwise, as aforesaid; or otherwise, I do pass the said several portions or parts of the girth on each side from the said pannel or cloth through a ring or loop only, or else through rings or loops affixed to the ends of a middle strap, girth, or piece beneath the chest of the horse or other animal; and do return each of the said parts or portions back again; and do fasten the same to the saddle, as aforesaid, on the same side, without passing the said several parts or portions across beneath the chest of the said horse or other animal, as in the former case, first herein mentioned: and by my said improvements I do prevent the saddle from slipping or working forwards upon the shoulders; and in the case last herein described, I do obtain a double purchase, and great firmness and security, in placing and retaining the saddle in its proper situation. And moreover, in such instances as those wherein the shape of the horse or other animal may require or render the same desirable, I do make that part of my said pannel or cloth which is situated immediately before the hooks or porcupine, prominent, or to project forward, so as to bear against the blades, taking care to cover the said parts, so as to prevent injury from their hardiness.

And farther, I do in other constructions and applications of my said improvements, form and make the saddle itself, having the hind part of the proper pannel thereof (or thereunto as commonly affixed), and no fore part; and I stuff the pannel or cloth herein first described, so as completely to answer and supply the effect of the fore part of the said proper pannel, which could or might have been otherwise applied, and make use of; or, in other constructions, I do stuff the whole of a saddle pannel, and do apply and use the same instead of my cloth before described and pointed out; and I do use the saddle without any pannel thereunto affixed as usual.

And farther, as one of my said improvements, I do declare that I do use cork, reduced to small fragments like coarse sawdust, by grinding or otherwise, as an elastic stuffing, instead of wool, flock hair, and the other materials commonly used, because the said cork is not liable to become clogged or impaired in its elasticity by wet; and in order to dispose the said material or ground cork in the most convenient manner, I do fill certain long bags or flexible pipes therewith, and do choak or bind the same at intervals; and I do form a plate or flat fabric thereof by joining the said long bags or flexible pipes together, side by side, and quilting through the whole.

In witness whereof, &c.

Description of a Method of preventing the Necessity of sweeping Chimnies; by the Rev. THOMAS RIDGE, *of Kimcote, near Lutterworth.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Thanks of the Society were voted to Mr. RIDGE *for this Communication.*

With an Engraving.

WITHOUT going into philosophical reasons of the plans I propose, I beg leave to state the following facts:—

1st, That every recess in a chimney, whether parallel to the shaft of the chimney (as is often the case in large chimnies made smaller) if totally closed up at the bottom, or even at right angles to the chimney, is in a great measure filled with soot long before the chimney becomes foul.

2dly, In a house I formerly occupied, there was a flue from a study, which was connected with an elbow of perhaps 8 feet into an old chimney, stopped up at the bottom;

tom; and whenever it was swept, the chimney-sweepers universally said, "they need not get up the other chimney, for there was no soot in it," or words to that effect. The reason had not occurred to me at that time, nor for a long time afterwards. Just before I left the house, the bottom of the chimney was accidently opened, when many bushels of soot were found deposited in the bottom of the upright chimney, below the part where the elbow entered it.

3dly, In visiting different manufactories, and other places where there are long flues, I have always learnt that they were continually bursting from the accumulation of soot. Considering the causes of which, together with other circumstances relative thereto, I was induced to make an experiment, by hanging my two coppers according to Fig. 2; one of which was used perhaps four times every week; the other about twenty times in the year. The result in four or five months was, that in the first, the whole body of soot was found in the receiver, and not half a pint of soot and dust together in the chimney. It then remained for seven or eight months, when, again the soot was found deposited in the receiver, and an equally small quantity of dust and soot in the chimney above. On opening the other at the end of nearly two years (when I left the house) the soot was found in the receiver, and none in the chimney.

4thly, In my present residence, the same experiment has been made for two years, and the same result as before.

I therefore now submit it to the public, and no doubt the idea once thrown out will be improved upon, and made applicable to many excellent purposes.

It has been my case to have lived in houses belonging to other persons; and where there has been no other opportunity of making the experiment on an extended scale and so bringing it in a more mature state before the public. As it is, they are presented with it, in the hope that it will be found applicable to their convenience, comfort, and security, in a very material degree; and also, in some measure, tend to relieve a degraded part of society from a most irksome and injurious employment.

I have exemplified the principle by a variety of sketches sent. I have to apologize for the indifference of the drawings, which I have been little accustomed to. The intention is only to show that plan which I conceive most convenient and suitable to the above excellent purpose; and which, from a conviction of its practicability and efficacy, I shall adopt upon a larger scale, whenever I have a house of my own, or a convenient opportunity.

REFERENCE TO THE ENGRAVING.

Fig. 3 (Plate IV.) is a section of a fire-place, chimney, and flue, with a soot receiver by the side.

A, the fire-place.

B, the bend or elbow of the chimney, communicating with the main chimney at D.

The main chimney C, extends from the floor to the top of the house; the open part conveys away the smoke into the air; the part below D, is the receptacle into which the soot falls, and from whence it is occasionally taken out at a small door E. This door should be of brick or stone, made to fit close, and should be put in with well-tempered clay or loam, so as totally to exclude the air.—*For the utter exclusion of any draft of air through the bottom or sides of the receiver, is the great principle.* Instead of a stone door, a double iron door might be made behind the skirting board in a sitting-room, and a sliding piece of the skirting board fitted to shut it, so as to conceal it from observation.

Fig. 4, is a section of a boiler, fixed on the same principle, in which F is the fire-place; G the boiler; H the flue communicating with the main chimney I; the soot falls into the receptable K, and is occasionally taken out from the door at the bottom. It is recommended, that the soot receptacle be made in all cases rather wider than the part above the elbow where the smoke enters, in order that the damp or cool air of the receptacle may have a greater effect upon the smoke as it passes.

The elbow, or part between the fire and the main chimney, should occasionally be swept by a servant, with a common house broom.

This principle is not confined merely to common fire-places or flues; but, agreeably to the sketches I have sent to the Society, may be extended to stoves, hot-walls, drying-rooms, &c. by forming proper soot receptacles, as circumstances may require.

I beg leave also to add a circumstance which has lately come to my knowledge, which confirms, in some measure, the efficacy of my plan.

Being lately at Mr. Lush's, of Banbury, I shewed him a sketch of my plan, which, having considered, he said he could confirm it from experience, though it had not occurred to him before. That, wishing to convert a part of his house, where there was no chimney, into a temporary back-kitchen, he could not build a chimney on the outside, it being a narrow passage leading to premises not belonging to him, and the chimney could not be carried through the rooms above. He therefore built a small chimney from the ground, in his own yard, and turned an arched flue nearly in the form of Fig. 1 into it, under the ceiling. There was a small hole left near the ground (in consequence of the mason observing, that perhaps some soot would fall down there), and stopped with two or three loose bricks. The soot did fall wholly, and was repeatedly taken out there. That, on the chimney being taken down above seven years after it had been built, the part of the chimney above the flue had no soot adhering to it, and the greater part was scarcely coloured with soot. I have stated the account in nearly his own words.

Description of improved Hobbles, which safely cast Horses down, preventing Danger to the Assistant and Pain to the Animal; by Mr. BRACY CLARK, *Veterinary Surgeon, Giltspur-street.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Silver Medal was voted to Mr. CLARK *for this Communication.*

With an Engraving.

THESE hobbles have now been in frequent use for six years, which long trial of them has served fully to prove their great utility and advantages over any apparatus hitherto used for the purpose; they are more easy to cast the horse, more durable, and more secure. They release, in a remarkable manner, all four legs at once after the operation for which the horse is cast is performed, instead of undoing a leg at once as heretofore. The King's Life Guards have used them more than five years, and found them so useful and convenient, that they have just ordered another set. Indeed their simplicity on inspection must make their advantages very obvious without a more particular explanation.

CERTIFICATES.

CERTIFICATES.

It is with great pleasure that I can conscientiously testify to the utility of the Hobbles invented by you, which I have used more than five years. Their durability is one advantage, but the greatest attending them is, from the firmly-fixed position of the animal, and the perfect security of the operator. My life was once endangered by the giving way of the old hobbles, but now I perform every operation without dread.

My assistants join me in the approval of them, they being secured from the danger heretofore incurred by freeing one leg at a time.

SAMUEL BLOXAM,
Veterinary Surgeon, 1st Life Guards.
Barracks, Jan. 30, 1815.

Certificates to a similar effect were received from Messrs. J. and W. Harrison, Veterinary Establishment, Little Moorfields.

R. H. Budd, No. 56, Lower East Smithfield.

John Payton, Assistant Veterinary Surgeon.

Charles Newport, Veterinary Surgeon, Gray's-Inn-Lane.

REFERENCE TO THE ENGRAVING.

As it is by practical improvements the veterinary art must be advanced in utility and estimation with the public; so I shall feel happy, if this little invention may be considered in a small degree contributing thereunto. This improvement in the apparatus for casting horses, and better securing them for operations, presented itself to me about six years ago; the great advantages of this plan having been fully confirmed by frequent use during this

period,

Fig. 1.

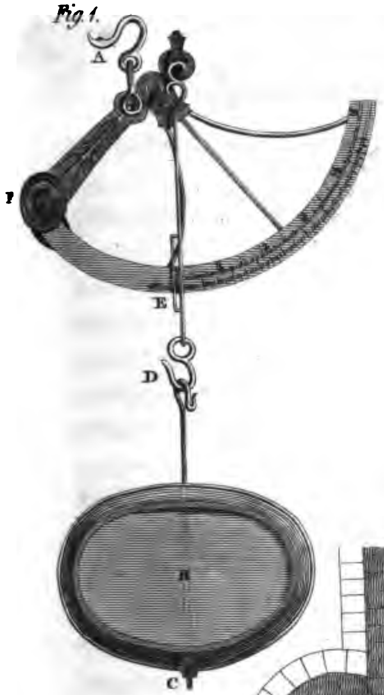


Fig. 2.

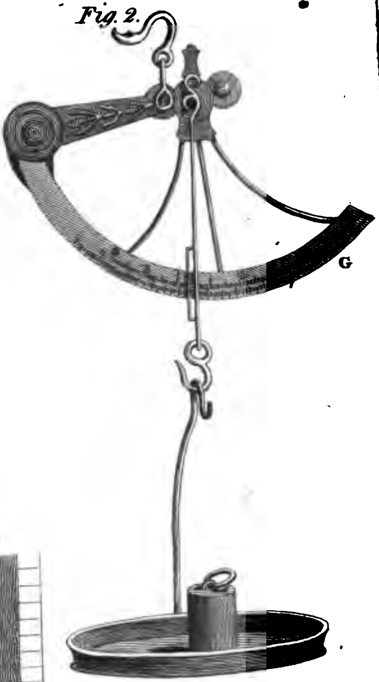


Fig. 3.

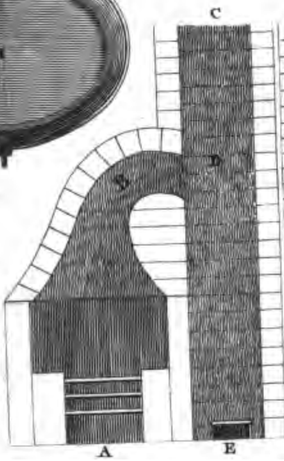


Fig. 4.

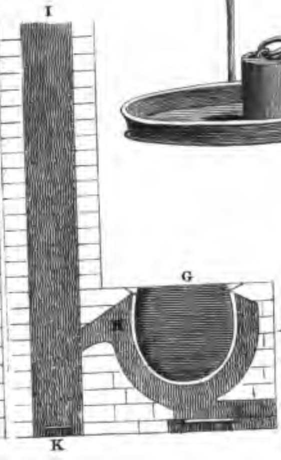


Fig. 5.

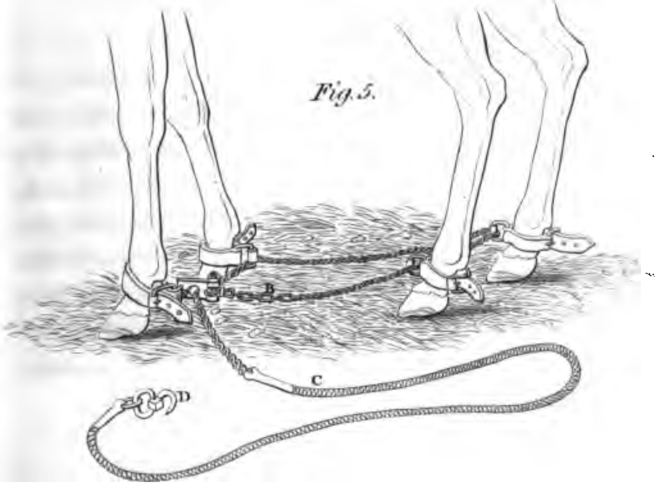
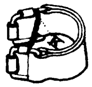


Fig. 6.



period, I have been induced to make it more publicly known.

In this way, the most painful operations may be performed upon this powerful animal with perfect safety; and I rejoice the more at the success of these means, as I well remember, in the commencement of my studies in this art, that casting the horse was attended with so much trouble and difficulty from being badly performed, that instead of it, severe twitches were had recourse to, during an operation, applied to the nose as well as the ears; and he was often cruelly beaten with whips and sticks, to make him stand quiet during the performance of firing or other operations, for which there can now be no occasion.

In casting horses after the common mode, some straw, enclosed in a knot, was used to form an obstacle to the return of the rope through the four rings; and, in order to insert it, it became necessary to relax the rope for a time, during which, if the horse struggled, he would draw the cord back through the rings, and sometimes get upon his legs again; this imperfection is wholly removed by the present apparatus. The knot of straw being also drawn tighter, and condensing by the struggling of the horse, would give a degree of liberty to the legs, that was often inconvenient in performing an operation, which is also removed by the present apparatus, which can be drawn as tight as you please, and afterwards is subjected to no relaxation. But a much greater advantage than the foregoing, is, that all the four legs are released at once, and the inconvenience and risk of undoing a leg at a time, after the old mode, is entirely done away. The friction and strain of these new hobbles are chiefly confined to the iron parts, which give them a duration in wearing that is almost endless. The iron chain, terminating the rope, passes or slides through the rings with less friction, if well made, than a rope would do; and, by the use of steel rollers, it requires much less force, or fewer men in casting the horse.

The apparatus itself is represented in the plate annexed, and the following brief description will enable the reader to form a correct idea of the nature of it:—one of the hobbles, it will be observed, is made different from the rest, which we call the principal or master hobble; it is seen on the near fore leg, and is always to be placed or fixed on the fore leg of that side of the horse that is designed to be uppermost when on the ground; the end of the chain is fastened to this hobble, by means of the moveable pin A, Fig. 5, which is prevented from falling out with any agitation of the apparatus, by having two or three turns of a screw in its upper part, under the thumb piece A. The chain B terminates in a swivel, received into a notch through which the pin passes, and the links of this end of the chain are made open and plain, for receiving the hook for fastening him. The rest of the links are twisted and shorter, to run more readily upon the rings. To this chain is attached a cord C. We have preferred one of those called patent ropes, being plated of strands of equal tension, and are found not only stronger but more flexible than common ones: at the extremity of this cord is attached, for convenient use, and to prevent its being lost, the oblong curved hook of iron D.

It would appear almost needless to describe the manner of using or applying the apparatus, as it is so simple, and the plate so plainly indicates it; it is evident that on drawing the rope, the legs are forced together, and the horse is thrown down, some straw being placed on the ground to receive him: he is no sooner down and the feet drawn together, than the hook D is passed through one of the open links of the chain, which, as it cannot then return back through the perforation in the plate E, he becomes perfectly fixed, far more conveniently and effectually, than by any noose or knot that could be devised.

The operation being performed, the removal of the pin A, sets the horse at liberty again, as the extremity of the chain can then pass without impediment through all the rings, and his four feet are all released at once.

Fig. 6, K, shews one of the hobbles separate, and on a larger scale. We may observe, that each hobble ring, except the principal, is provided with a steel roller, or case of plate steel, which, turning readily upon the iron, serves to diminish friction, though it has been found, if made simply, of a large half-round iron ring, in which way this apparatus has been used several years in the King's body guard, to answer particularly well, yet we think the rollers preferable; and it may not be without its use to remark, that if the steel moveable cases or rollers are resorted to, they should be made of very stout plate steel, so strong that the chain should not, in passing through the rings, or in the struggles of the horse after he is down, be subject at all to force or indent them, which would render them perfectly useless.

The horse's tail having great command of him under the circumstances of his being poised and about to fall, has been usually my post of duty in this process; and frequently, in the moment of balancing, the opportunity is afforded of deciding the fall on the side we wish; a steady confidential man also should be placed at the head, and another of this description should manage the rope next the hobbles, taking a short hold almost close to the apparatus, pushing with the other hand against the shoulder or side of the horse, and renewing his hold as the rope passes; this, however, requires some adroitness, as the horse may, if it is resorted to too soon, lean towards it, which they are apt to do when any thing is pressing against them, and so fall on the near side, that it should be desisted from if this is likely to take place, but may much assist if duly used.

In the moment of pulling the rope stationed at the tail, I take the opportunity with my foot of touching pretty sharply the hind leg on the off side, or side from the casting rope; and as he lifts up, it is drawn inwards towards the centre of the body, and greatly assists in the operation, determining also in general his fall on that side.

One hint more I might also subjoin, in respect to handling the horse; for, it is very common to see the shoeing-smiths about any operation of this sort, of a painful kind, approach the horse with a timidity and suspicion, and touch his legs and other parts with their fingers' ends, thereby creating an unnecessary alarm and irritation: he should, on these occasions, be approached with confidence, and the flat hand be used with great freedom.

Description of a Weighing Machine for Family Use; by Mr. JAMES BRABY, *of Pedlar's Acre, Lambeth.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Silver Medal was voted to Mr. BRABY *for this Communication.*

With an Engraving.

I BEG leave to lay before the Society of Arts, &c. a new balance of my invention, with a constant self-acting weight, by which goods of any description may be weighed with accuracy. I call it a domestic balance from its being more particularly adapted for family purposes, such as weighing meat, bread, butter, &c. for which I conceive it will be far preferable to weights and scales, the weights being often lost or misplaced by servants. The common steel-yard is also unhandy for domestic use, as it has no scale to place the goods in, nor will it weigh sufficiently accurate to detect short weight in small articles. I trust this new balance will not be liable to these objections; it can be made to carry any weight and will take up very little room in a kitchen, or any other place, as it hangs flat against the wall when not in use; is not liable to be damaged or put out of repair, and always ready for use without any trouble.

REFERENCE TO THE ENGRAVING.

The fulcrum or point of suspension in this instrument is a lever of the first order.

The weight is fixed at the longer arm of the lever. The balance, or scale for weighing, is to be suspended on one of the two centres situated on the shorter arm of the lever.

The graduated scale of weights is divided upon a segment of a circle, occupying about 140 degrees, the divisions being in two rows, each calculated for and tending to the respective centre upon which the balance and its index is to be suspended.

Fig. 1 (Plate IV), represents the domestic balance, which is to be suspended by its hook A, from a pin in the wall, and for the convenience of occupying little room, the scale B is here turned up flat by a joint C; it thus permits articles too large for the scale to be hung upon the hook D, to be weighed.

The balance and index in this figure are placed upon that centre which is most distant from the fulcrum, and is intended for weighing goods under five pounds. The inner row of divisions tending to this centre graduated upon the arch up to No. 5, represent pounds subdivided into halves, quarters, and ounces; the index, which is a thin edge E, on the side of the balance rod in this figure, stands at 0, or Zero, the scale being empty. According to the quantity of goods put into the scale, the weight F, at the longer end of the lever, will rise until it hangs in equilibrio; the index will then shew, by the mark of the graduation, the weight of the goods in the scale.

To weigh any articles exceeding five pounds weight, the balance rod is to be suspended upon that centre or pivot nearest to the fulcrum, as shewn in Fig. 2; the purchase being less, a greater weight may be suspended in equilibrio; in this case the outer row of divisions G, intersected by the index, will shew any weight in the balance very accurately as far as fifteen pounds, the extent for which this instrument was intended. In this figure the scale is let down in the position most favourable for articles to be generally weighed, the weight within it serving merely to shew how the article to be weighed is to be placed.

⁂ Since the above apparatus was rewarded by the Society, Mr. Braby has made considerable improvements therein, by which a machine of the same size will weigh double the weight, and accurately shew the divisions of a pound in half-ounces. He has also placed one of the improved machines in the Society's Repository.

Mr. Braby has made several machines upon the same principle, capable of weighing one hundred weight, but the sizes he recommends as most generally useful are those to weigh half a hundred.

On

On Soils: their constituent Parts. On the Analysis of Soils. Of the Uses of the Soil. Of the Rocks and Strata found beneath Soils. Of the Improvement of Soil.

By Sir HUMPHRY DAVY, LL.D. F.R.S. L.&E., &c.

From ELEMENTS OF AGRICULTURAL CHEMISTRY.

NO subjects are of more importance to the farmer than the nature and improvement of soils; and no parts of the doctrines of agriculture are more capable of being illustrated by chemical enquiries.

Soils are extremely diversified in appearance and quality; yet as it was stated in the introductory lecture*, they consist of different proportions of the same elements; which are in various states of chemical combination, or mechanical mixture.

The substances which constitute soils have been already mentioned. They are certain compounds of the earths, silica, lime, alumina, magnesia, and of the oxides of iron and manganesum; and animal and vegetable matters in a decomposing state, and saline, acid, or alkaline combinations.

In all chemical experiments on the composition of soils connected with agriculture, the constituent parts obtained are compounds; and they act as compounds in nature: it is in this state, therefore, that I shall describe their characteristic properties.

1. *Silica,* or the earth of *flints,* in its pure and crystallized form, is the substance known by the name of rock crystal, or Cornish diamond. As it is procured by chemists, it appears in the form of a white impalpable powder. It is not soluble in the common acids, but

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* See Repertory, Vol. XXVII.

dissolves by heat in fixed alkaline lixivia. It is an incombustible substance, for it is saturated with oxygene. I have proved it to be a compound of oxygene, and the peculiar combustible body which I have named silicum; and from the experiments of Berzelius, it is probable that it contains nearly equal weights of these two elements.

2. These sensible properties of *lime* are well known. It exists in soils usually united to carbonic acid; which is easily disengaged from it by the attraction of the common acids. It is sometimes found combined with the phosphoric and sulphuric acids. Its chemical properties and agencies in its pure state will be described in the Lecture on Manures obtained from the mineral kingdom. It is soluble in nitric and muriatic acids, and forms a substance with sulphuric acid, difficult of solution, called gypsum. It is not soluble in alkaline solutions. It consists of one proportion 40 of the peculiar metallic substance, which I have named calcium; and one proportion 15 of oxygene.

3. *Alumina* exists in a pure and crystallized state in the white sapphire, and united to a little oxide of iron and silica in the other oriental gems. In the state in which it is procured by chemists, it appears as a white powder, soluble in acids and fixed alkaline liquors. From my experiments it appears, that alumina consists of one proportion 33 of aluminum, and one 15 of oxygene.

4. *Magnesia* exists in a pure crystallized state, constituting a mineral like talc found in North America. In its common form it is the *magnesia usta*, or calcined magnesia of druggists. It generally exists in soils combined with carbonic acid. It is soluble in all the mineral acids; but not in alkaline lixivia. It is distinguished from the other earths found in soils by its ready solubility in solutions of alkaline carbonates, saturated with carbonic acid. It appears to consist of 38 magnesium and 15 oxygene.

5. There are two well-known *oxides of iron*, the black and the brown. The black is the substance that flies off when red hot iron is hammered. The brown oxide may be formed by keeping the black oxide red hot, for a long time in contact with air. The first seems to consist of one proportion of iron 103, and two of oxygene 30; and the second of one proportion of iron 103, and three proportions of oxygene 45. The oxides of iron sometimes exist in soils combined with carbonic acid. They are easily distinguished from other substances by their giving when dissolved in acids a back colour to solution of galls, and a bright blue precipitate to solution of prussiate of potassa and iron.

6. *The oxide of manganesum* is the substance commonly called manganese, and used in bleaching. It appears to be composed of one proportion of manganesum 113, and three of oxygene 45. It is distinguished from the other substance found in soils, by its property of decomposing muriatic acid, and converting it into chlorine.

Vegetable and animal matters are known by their sensible qualities, and by their property of being decomposed by heat. Their characters may be learnt from the details in the last lecture.

8. The *saline compounds* found in soils, are common salt, sulphate of magnesia, sometimes sulphate of iron, nitrates of lime and of magnesia, sulphate of potassa, and carbonates of potassa and soda. To describe their characters minutely will be unnecessary; the tests for most of them have been noticed in page 114 of these Lectures.

The silica in soils is usually combined with alumina and oxide of iron, or with alumina, lime, magnesia, and oxide of iron, forming gravel and sand of different degrees of fineness. The carbonate of lime is usually in an impalpable form: but sometimes in the state of calcareous sand.

The magnesia, if not combined in the gravel and sand of soil, is in a fine powder united to carbonic acid. The impalpable part of the soil, which is usually called clay or loam, consists of silica, alumina, lime, and magnesia; and is, in fact, usually of the same composition as the hard sand, but more finely divided. The vegetable, or animal matters, (and the first is by far the most common in soils) exists in different states of decomposition. They are sometimes fibrous, sometimes entirely broken down and mixed with the soil.

To form a just idea of soils, it is necessary to conceive different rocks decomposed, or ground into parts and powder of different degrees of fineness; some of their soluble parts dissolved by water, and that water adhering to the mass, and the whole mixed with larger or smaller quantities of the remains of vegetables and animals, in different stages of decay.

It will be necessary to describe the processes by which all the varieties of soils may be analysed. I shall be minute in these particulars, and, I fear, tedious; but the philosophical farmer will, I trust, feel the propriety of full details on this subject.

The instruments required for the analysis of soils are few, and but little expensive. They are a balance capable of containing a quarter of a pound of common soil, and capable of turning when loaded, with a grain; a set of weights from a quarter of a pound troy to a grain; a wire sieve, sufficiently coarse to admit a mustard seed through its apertures; an Argand lamp and stand; some glass bottles; Hessian crucibles; porcelain, or queen's ware evaporating basins; a Wedgewood pestle and mortar; some filtres made of half a sheet of blotting paper, folded so as to contain a pint of liquid, and greased at the edges; a bone knife, and an apparatus for collecting and measuring aeriform fluids.

The chemical substances or re-agents required for separating the constituent parts of the soil, have, for the most part, been mentioned before: they are muriatic acid *(spirit of salt)*, sulphuric acid, pure volatile alkali dissolved in water, solution of prussiate of potash and iron, succinate of ammonia, soap lye, or solution of potassa, solutions of carbonate of ammonia, of muriate of ammonia, of neutral carbonate of potash, and nitrate of ammoniac.

In cases when the general nature of the soil of a field is to be ascertained, specimens of it should be taken from different places, two or three inches below the surface, and examined as to the similarity of their properties. It sometimes happens, that upon plains the whole of the upper stratum of the land is of the same kind; and in this case, one analysis will be sufficient; but in vallies, and near the beds of rivers, there are very great differences, and it now and then occurs that one part of a field is calcareous, and another part siliceous; and in this case, and in analogous cases, the portions different from each other should be separately submitted to experiment.

Soils when collected, if they cannot be immediately examined, should be preserved in phials quite filled with them, and closed with ground glass stoppers.

The quantity of soil most convenient for a perfect analysis, is from two to four hundred grains. It should be collected in dry weather, and exposed to the atmosphere till it becomes dry to the touch.

The specific gravity of a soil, or the relation of its weight to that of water, may be ascertained by introducing into a phial, which will contain a known quantity of water, equal volumes of water and of soil, and this may be easily done by pouring in water till it is half full, and then adding the soil till the fluid rises to the mouth; the difference between the weight of the soil and that of the water, will give the result. Thus if the bottle contains four hundred grains of water, and gains two hundred grains when half filled with water and half with soil, the specific gravity of the soil will be 2; that is, it will be twice as heavy as water; and if it gained one hundred and sixty-five grains, its specific gravity would be 1825, water being 1000.

It is of importance, that the specific gravity of a soil should be known, as it affords an indication of the quantity of animal and vegetable matter it contains; these substances being always most abundant in the lighter soils.

The other physical properties of soils should likewise be examined before the analysis is made, as they denote, to a certain extent, their composition, and serve as guides in directing the experiments. Thus siliceous soils are generally rough to the touch, and scratch glass when rubbed upon it; ferruginous soils are of a red or yellow colour; and calcareous soils are soft.

1. Soils, though as dry as they can be made by continued exposure to air, in all cases still contain a considerable quantity of water, which adheres with great obstinacy to the earths and animal and vegetable matter, and can only be driven off from them by a considerable degree of heat. The first process of analysis is, to free the given weight of soil from as much of this water as possible, without, in other respects, affecting its composition; and this may be done by heating it for ten or twelve minutes over an Argand's lamp, in a basin of porcelain, to a temperature equal to 300 Fahrenheit; and if a thermometer is not used, the proper degree may be easily ascertained, by keeping a piece of wood in contact with the bottom of the dish; as long as the colour of the wood

remains unaltered, the heat is not too high; but when the wood begins to be charred, the process must be stopped. A small quantity of water will perhaps remain in the soil even after this operation, but it always affords useful comparative results; and if a higher temperature were employed, the vegetable or animal matter would undergo decomposition, and in consequence the experiment be wholly unsatisfactory.

The loss of weight in the process should be carefully noted, and when in four hundred grains of soil it reaches as high as 50, the soil may be considered as in the greatest degree absorbent, and retentive of water, and will generally be found to contain much vegetable or animal matter, or a large proportion of aluminous earth. When the loss is only from 20 to 10, the land may be considered as only slightly absorbent and retentive, and siliceous earth probably forms the greatest part of it.

2. None of the loose stones, gravel, or large vegetable fibres should be divided from the pure soil till after the water is drawn off; for these bodies are themselves often highly absorbent and retentive, and in consequence influence the fertility of the land. The next process, however, after that of heating, should be their separation; which may be easily accomplished by the sieve, after the soil has been gently bruised in a mortar. The weights of the vegetable fibres or wood, and of the gravel and stones, should be separately noted down, and the nature of the last ascertained; if calcareous, they will effervesce with acids; if siliceous, they will be sufficiently hard to scratch glass; and if of the common aluminous class of stones, they will be soft, easily cut with a knife, and incapable of effervescing with acids.

3. The greater number of soils, besides gravel and stones, contain larger or smaller proportions of sand, of

different degrees of fineness; and it is a necessary operation, the next in the process of analysis, to detach them from the parts in a state of more minute division, such as clay, loam, marle, vegetable and animal matter, and the matter soluble in water. This may be effected in a way sufficiently accurate by boiling the soil in three or four times its weight of water; and when the texture of the soil is broken down, and the water cool, by agitating the parts together, and then suffering them to rest. In this case, the coarse sand will generally separate in a minute, and the finer in two or three minutes, whilst the highly divided earthy, animal, or vegetable matter will remain in a state of mechanical suspension for a much longer time; so that by pouring the water from the bottom of the vessel, after one, two, or three minutes, the sand will be principally separated from the other substances, which, with the water containing them, must be poured into a filtre, and after the water has passed through, collected, dried, and weighed. The sand must likewise be weighed, and the respective quantities noted down. The water of lixiviation must be preserved, as it will be found to contain the saline and soluble animal or vegetable matters, if any exist in the soil.

4. By the process of washing and filtration, the soil is separated into two portions, the most important of which is generally the finely divided matter. A minute analysis of the sand is seldom or never necessary, and its nature may be detected in the same manner as that of the stones or gravel. It is always either siliceous sand, or calcareous sand, or a mixture of both. If it consist wholly of carbonate of lime, it will be rapidly soluble in muriatic acid, with effervescence; but if it consist partly of this substance, and partly of siliceous matter, the respective quantities may be ascertained by weighing the residuum

after the action of the acid, which must be applied till the mixture has acquired a sour taste, and has ceased to effervesce. This residuum is the siliceous part: it must be washed, dried, and heated strongly in a crucible; the difference between the weight of it and the weight of the whole, indicates the proportion of calcareous sand.

5. The finely divided matter of the soil is usually very compound in its nature; it sometimes contains all the four primitive earths of soils, as well as animal and vegetable matter; and to ascertain the proportions of these with tolerable accuracy, is the most difficult part of the subject.

The first process to be performed, in this part of the analysis, is the exposure of the fine matter of the soil to the action of muriatic acid. This substance should be poured upon the earthy matter in an evaporating basin, in a quantity equal to twice the weight of the earthy matter; but diluted with double its volume of water. The mixture should be often stirred, and suffered to remain for an hour, or an hour and a half, before it is examined.

If any carbonate of lime or of magnesia exist in the soil, they will have been dissolved in this time by the acid, which sometimes takes up likewise a little oxide of iron; but very seldom any alumina.

The fluid should be passed through a filtre; the solid matter collected, washed with rain water, dried at a moderate heat, and weighed. Its loss will denote the quantity of solid matter taken up. The washings must be added to the solution, which if not sour to the taste, must be made so by the addition of fresh acid, when a little solution of prussiate of potassa and iron must be mixed with the whole. If a blue precipitate occurs, it denotes the presence of oxide of iron, and the solution of the prussiate must be dropped in till no farther effect is produced. To ascertain its quantity, it must be collected in the same manner as other solid precipitates, and heated red; the result is oxide of iron, which may be mixed with a little oxide of manganesum.

Into the fluid freed from oxide of iron, a solution of neutralized carbonate of potash must be poured till all effervescence ceases in it, and till its taste and smell indicate a considerable excess of alkaline salt.

The precipitate that falls down is carbonate of lime; it must be collected on the filtre, and dried at a heat below that of redness.

The remaining fluid must be boiled for a quarter of an hour, when the magnesia, if any exist, will be precipitated from it, combined with carbonic acid, and its quantity is to be ascertained in the same manner as that of the carbonate of lime.

If any minute proportion of alumina should, from peculiar circumstances, be dissolved by the acid, it will be found in the precipitate with the carbonate of lime, and it may be separated from it by boiling it for a few minutes with soap lye, sufficient to cover the solid matter; this substance dissolves alumina, without acting upon carbonate of lime.

Should the finely divided soil be sufficiently calcareous to effervesce very strongly with acids, a very simple method may be adopted for ascertaining the quantity of carbonate of lime, and one sufficiently accurate in all common cases.

Carbonate of lime, in all its states, contains a determinate proportion of carbonic acid, *i. e.* nearly 43 per cent., so that when the quantity of this elastic fluid, given out by any soil during the solution of its calcareous matter in an acid is known, either in weight or measure, the quantity of carbonate of lime may be easily discovered.

When the process by diminution of weight is employed, two parts of the acid and one part of the matter of the soil must be weighed in two separate bottles, and very slowly mixed together till the effervescence ceases; the difference between their weight before and after the experiment, denotes the quantity of carbonic acid lost; for every four grains and a quarter of which, ten grains of carbonate of lime must be estimated.

TO BE CONTINUED IN OUR NEXT.

Essay on the Preparation of Opium in Britain; by JAMES HOWISON, *Esq. of Crossburn House, Lanarkshire.*

From the TRANSACTIONS of the CALEDONIAN HORTICULTURAL SOCIETY.

IT is necessary to premise to the Society, that the accompanying specimen of opium was made under circumstances, as to soil, situation, species of poppy, distance planted, instruments used for extracting and gathering the milk, and future preparation, which, after much experience, I consider as best suited to the climate of Britain.

I am therefore of opinion, that a short account of the steps followed by me, under each of these heads, will convey to the Society a more distinct idea of my method, than any other arrangement I could adopt.

1. *Soil.*

A rich light black soil of considerable depth, is most favourable for the growth of poppies. In Bengal where 200,000 lbs. of opium are made annually, notwithstanding the soil is entirely formed from the deposite of the Ganges, the Hindoos constantly apply manure to their poppy crops, and to these only. This, added to my own ex-

experience, leads me to think that there is little danger of poppy land being too rich.

2. *Situation.*

As poppies send down long tap roots, with few lateral fibres, and with their large heads rise to a very considerable height, they of all crops are the most liable to be hurt by winds. A sheltered situation, where these prevail, is therefore indispensable, otherwise a very small proportion of the crop will be found standing when the season for gathering the opium arrives.

3. *Species of Poppy.*

After many trials with the large single white poppy, I have now entirely given up its cultivation, for the purpose of making opium. Independent of the objections stated under last head, to which, from its great size and height, it is peculiarly liable, it never in this climate arrives to that perfection as to yield milk of proper consistence for making good opium. I cannot say in the usual sense of the word, it does not ripen, for although upon wounding the capsule, not a drop of milk appears, or that of a very watery consistence, still the seed will grow well. The white poppy has another great defect, *viz.* the few that arrive at a state to afford good milk, only continue so for a day, and any attempt to bleed them a little sooner, or later, would be without success. I therefore give the preference to the double red garden poppy, and its varieties, as being in a great measure free from all the above objections.

It is proper, however, to notice here, that the large single white poppy, is that universally cultivated for opium in Bengal; and that in some experiments I made with it about ten miles from London, I found its milk more in quantity, and better in quality, than in Scotland;

still its period of giving it is very limited. Owing to the advantages it has from its great size, it is not improbable that, in warm climates, where high winds seldom prevail, it would be entitled to a preference over every other species.

4. *Distance.*

This is a circumstance of more importance than at first sight would appear, as the expedition in bleeding and gathering depends greatly on the regular distance of one plant from another. Near London, the fields of poppies for the use of the druggists, are all sown broadcast, owing to which, I found more time necessary to bleed 100 poppies, than would have been sufficient for 1000 on the drill system; and what was worse, half of the crop broken down and trampled upon, before the opium from the remainder could be gathered.

I therefore divide my poppy grounds into four feet beds, with alleys sixteen inches wide. On those about the end of March, I sow four drills, which admit of their being 9½ inches from each other, and when the plants are of a proper size, I thin them out to the same distance in the rows. By this arrangement, the labourers can bleed and gather from two rows in going up, and the same number in coming down, without breaking or missing a single poppy. To prevent the crops being all ripe at the same time, it is necessary to divide them into different sowings, allowing a few days to intervene between each; and as the poppy stands the winter of this climate, the early crops might be sown during the August of the preceding year.

5. *Extracting the Opium.*

As the poppies sown about the end of March will begin to change from green to white about the middle of July, this crisis must be watched with some attention, as marking the period for commencing the bleeding, and which if neglected for but a few days, the opium of that crop would be completely lost.

It is to the alterations I have made in conducting this part of the process, that I consider my method as having a decided advantage over that formerly in use, especially for manufacturing opium in Britain.

In Bengal the instrument used for wounding the poppy heads, is a small knife, fixed in a wooden handle, with which the labourers make three or four longitudinal incisions, according to the size of the head. From the peculiar structure of the vessels containing the milky fluid, they are so instantaneously emptied, that a second wound being given on the opposite side of the capsule, following the first as quickly as possible, will not yield a fourth part of the milk. This circumstance would have rendered one wound sufficient, had it not been necessary to spread the flowing milk on a large surface, and thereby endeavour to prevent its running upon the ground, by which, after all their care, one third of the crop is lost.

To obviate this inconvenience, the Society will observe, that the instrument employed by me for the same purpose, consists of a brass ring made to fit the middle finger of the operator, in which is fixed a wheel set with lancets, which, when put in motion, by drawing the hand along the poppy head, makes, with great expedition, whatever number of perforations are wanted, each giving out its distinct drop of milk, by which a great surface is afforded both for support and evaporation. By this instrument, the milk vessels are rather perforated than cut, which produces more a slow exudation than a wasteful stream, the unavoidable consequence of the method formerly in use. In this wet climate it is attended with another advantage, the saving the seed, which is in general lost when the incisions are made into the capsule with a knife;

these naturally enlarging, admit of the rain, which instantly causes the seed to germinate.

6. *Gathering the Opium.*

The difficulty of accomplishing this, with any degree of success, has justly been considered the principal obstacle to the manufacture of opium in Britain.

In Bengal, where the rains are so periodical that during the opium gathering season it may be predicted that none will fall, with nearly the same certainty as that the sun when set will again rise, the custom of allowing the milk to thicken, by remaining for a time on the capsule, is highly judicious. But in this climate, where the serenest day is often followed by a night of deluging rains, adopting that plan would be worse than trusting our fortune to the chance of a lottery.

From my being convinced that the juice of the poppy undergoes no change in its properties by exposure to the air, farther than acquiring a greater consistence from the evaporation of its watery part, I divide my labourers into two parties, *bleeders* and *gatherers*; the former going before the latter more or less, according to the appearance of the weather; by which arrangement, the gathering *immediately* follows the bleeding, unless both are prevented by rain. Were I to follow the Bengal method, the produce of the day's labour, however extensive, would be complelely lost by a single shower during the night.

For gathering, I use the tin flask, sent for the inspection of the Society, instead of the knife and cup of the Hindoos. By this change it is evident, that much is gained in the saving of labour. The opium by them is first collected with the knife, and by a second operation deposited in the cup; whereas my gatherers scrape the opium off with the mouth of the flask, which is flattened about half an inch for that purpose, and which at the same time conveys it into the flask, which is calculated to hold a day's gathering. The small cord attached is intended to hang the flask to a button, or button-hole, to save the trouble of placing it on the ground when the hand is wanted for any other purpose.

On finishing the labours of the day, the milk collected is put into a shallow vessel, and afterwards exposed to the rays of the sun, in a room where there is a free circulation of air. As the black coats form on the surface of the milk, these are to be forced down, until the whole acquires a proper colour and consistence. Were the manufacture of opium attempted on a large scale, a drying house would be necessary, as in this climate the evaporation from the heat of the sun alone is too slow. If built upon the plan of a hot-house, it would answer completely; as by placing the vessels containing the milk upon the flues, the additional heat wanted would be obtained, while the rays of the sun would have free access to the milk through the glass.

Conclusion.

Although, with all our improvements, there is but little probability of our ever making opium in Britain, in sufficient quantity to form an export, there can remain no doubt of the practicability of preparing it with advantage, to answer every domestic purpose.

To the amateur gardener, and the members of his family, the cultivation of the poppy, and preparation of the opium, to an extent sufficient for the supply of himself and neighbouring poor with that valuable medicine, might constitute a rational and delightful amusement.

The cake of opium from which the specimen sent was taken, weighed eight ounces and a half, and was collected from a field of poppies, measuring about five falls, by a young lady, in the course of a fortnight, the bleeding and gathering being wholly done by her at her leisure hours, with the instruments now under the inspection of the Society.

It is proper to state, that our situation here is more distant from the sea than almost any other in Scotland; is subject to frequent rains, and in consequence has little sun, the presence of which I consider as essential to the production of good opium.

The Prize Medal proposed by the Caledonian Horticultural Society, was awarded to the specimen of British opium sent with the preceding paper. That specimen was afterwards put into the hands of Dr. Duncan *senior*, that it might be tried in actual practice. During Dr. Duncan's attendance on the Clinical Wards in the Royal Infirmary, from the beginning of February to the end of April 1814, he had many opportunities of exhibiting it; and he repeatedly mentioned in his lectures, when speaking of particular cases in which it had been employed, that Dr. Howison's British opium had proved, in its power of inducing sleep, of alleviating pain, and of restraining looseness, in no degree inferior to the best Turkey opium.

Many students attending the Clinical Wards had also the same opportunity of witnessing its efficacy.

On pruning old worn out Apple and Pear Trees upon Walls, so as to bring them into a bearing State again; by Mr. JOHN YOUNG, *of Belmont Castle, Perthshire.*

From the TRANSACTIONS of the CALEDONIAN HORTICULTURAL SOCIETY.

WE commonly see in old gardens, numbers of apple and pear trees occupying a great extent of wall, and yet producing but very little fruit, and even what they do carry, very inferior in quality to what the tree formerly produced. This may be ascribed, generally, to the great extent of wall that each tree is intended to cover; the consequence of which is, the tree when large seldom produces fruit, but at the extremities of the branches, and if there should by chance be a few fruit scattered over the body of the tree, from their being produced from old cankered spurs, they are generally hard and kernelly, so as to be scarcely fit for eating.

Having once entered a place where a great number of the trees were such as has been above described, being completely covered with long cankered spurs, considerably advanced from the wall, with scarce any blossom buds upon them, excepting a few upon the extremities, as the heading down might have been considered too great a sacrifice, and probably not been allowed, I bethought myself how they might be renewed, at the same time retaining the chance of what fruit they might produce. Therefore, in the winter pruning, I thinned out all the coarse and cankered spurs, particularly those that had no appearance of blossom, regularly over the whole surface of the tree, reserving all such as were best situated, and all that had blossom upon them, so as the tree might be regularly furnished, and not have a naked appearance. After this discipline, the trees made fine vigorous shoots the following summer, from the roots having less to support; and in the summer dressing I selected a number of the best of the shoots in different parts of the tree (particularly near the stem, where they could be laid in conveniently), and trained them in at full length between the branches, taking off any long barren spur on either side, that shaded the new laid in shoot, so as to admit all the sun and air possible.

The second winter's pruning consisted in thinning out any of the remaining cankered barren spurs, regularly over the tree, on each side of the young shoots. And in the following summer a few more young shoots were laid in, always making as much room for them as possible, by displacing barren spurs as they advanced in length; and in autumn I had the satisfaction of finding all the shoots laid in the preceding summer full of fine blossom-buds.

The third winter the trees were gone over as before, and all the spurs that remained upon the old branches, on either side of the first laid in shoots, were entirely taken off, so as they might have all the influence of the sun and air; and in the succeeding spring the first laid in shoots pushed fine healthy blossom, which set kindly, and continued through the summer to swell freely, so that at the time of gathering the crops of the respective kinds, they had by far exceeded my most sanguine expectation, they being large and clean-skinned fruit; whereas what was produced upon the old branches were very inferior in quality, so much so, that had the produce of the old branches and those of the new shoots been laid in separate parcels, no person could have supposed them to be the produce of the same tree.

In the end of autumn, the third season, the state of the trees was thus: a considerable number of shoots that were trained-in the first summer, and which had produced a crop of fruit this, with the appearance of fine blossom-buds for next season upon their extremities; the shoots of the second summer full of fine bold blossom buds, and a few more shoots trained-in this summer in regular advance to continue the succession. The plan that I had formed for myself, for their future management, was this: In the following winter's pruning, to have cut out a number of the worst of the old branches, either back to the body of the tree, or to the part where any of the young branches might arise from them, continuing to lay in a few young shoots every summer, as a supply for what was removed, always continuing occasionally to take out some of the old branches till the whole tree was renovated, and a regular supply of young bearing branches produced over the whole tree.—But a change of situation at this time prevented me from following out the practice to the extent I now could have wished, as it would have enabled me to have placed the subject in a clearer point of view.

It seems unnecessary to mention the names either of the apples or pears thus treated, as all the different kinds succeeded equally well.

I have been led to think, from the above practice, that we generally give apples and pears too much space of wall, as by the time they reach their utmost limits, they begin to turn barren in the middle; whereas, by giving them less space, if the walls are of a sufficient height, we may have three trees for two, which, if under a proper system of training, would not only produce more, but also finer fruit, and likewise afford room for more trees, which would, if wanted, admit a greater variety for the dessert.

The Cressane is one of our finest pears, and the tree is a free grower; yet the trees seldom produce fruit but upon the young wood; I therefore think they might be made to produce better crops and finer fruit, if they were trained in the way we train the peach; making allowance for the difference of time the young wood of the one takes to produce fruit from the other. This, and the distance at which trees might be planted, I mention only as my own conjecture; flattering myself the idea may be taken up (if not already done) by other horticulturists, and our doubts removed on the subject.

Method of preparing Horn for Lanterns, &c. as practised in China.

From the ANNALES DES ARTS.

THE horn of animals is a substance moderately soft, tenacious, transparent, and susceptible of being divided and cut into different shapes; it is this that distinguishes it from bone. Tortoise-shell is also of the same nature as horn, but it is shaded or stained, instead of being of an uniform colour.

The properties we have just described render horn very proper to be worked or wrought in various ways. We shall here only treat of the processes used for softening, cutting, soldering, and cementing the horn for the purpose of making lantern leaves and other similar objects. In China, where they make a great number of horn lanterns, they macerate the horn in water, in order to separate it from the pith. This operation requires a fortnight in summer and a month in winter; when it is completed, the horn is taken by the point and violently shaken, to make the pith fall out; it is then sawed longways on the smooth side, having been previously boiled in water for about thirty minutes, and the pieces are again thrown into boiling water, which softens them.

The horn is split by means of a small iron chissel, which is struck with a hammer; the thick pieces are divided into three leaves, and the thin ones into two: the horns of very young animals, which are not more than three lines thick, are not split at all.

The split pieces are soaked in boiling water; when they are sufficiently softened, they are made equally thick in all parts, by scraping them with a sharp instrument. They are then once more put into boiling water, and afterwards pressed. The operation of pressing horn is performed with a beam six feet long, two wide, and eighteen inches thick; in the middle of which is a square hole of nine inches diameter; in this hole the leaves of horn are placed one upon the other, being separated by warm iron plates. The space not occupied by the leaves is filled with bits of wood and chips, which are knocked in with a hammer, and which serve to smooth and flatten the leaves on which the press is made to act afterwards.

To solder or cement the leaves, so that the joining may not be perceptible, the workman places himself near a stove, which serves to heat a pair of pincers; when he has made the horn sufficiently warm over the fire, he rubs the outside of the two pieces intended to be joined, turns one up and the other down, until the two pieces fit each other: the edge of each leaf should be four lines in front.

The leaves being thus prepared, the workman takes the warm pincers and runs them along the edges of the two leaves, which he places in a suitable position. If the pieces join well, he wets the edge that is to be soldered, and afterwards uses the pincers. Thus such a perfect union is effected between the two leaves, that they appear as if they had never been separate. The surface is then scraped, in order to remove the inequalities that remain; and it is afterwards polished by rubbing with tripoly and water.

The method of staining horn to give it the appearance of tortoise-shell is as follows.

1st. A solution of gold in *aqua regia* (nitro-muriatic acid) spread over the surface of the horn, gives it a red colour. 2d. a solution of silver in nitric acid produces a black colour. 3d. if the horn be stained with a warm solution of mercury in nitric acid, it takes a brown colour.

In several towns of France and Holland they mould horn into powder flasks, sweetmeat boxes, &c.; the same is also done in Paris. The cuttings of horn may be united into a solid body, and moulded in the same manner as tortoise-shell; in both cases care must be taken that it be not touched with the fingers or any greasy substance, which would prevent the union from being perfect, consequently wooden forks must be used to move it in the different lotions of warm water in which it is necessary to put it.

The temperature to agglomerate the cuttings of horn in the moulds should be more elevated than for the fusion of tortoise-shell; the degree is not yet determined, as it is for tortoise-shell.

This operation should be conducted in an apparatus constructed for the purpose, in order that there may be no risk of burning the horn.

On the Composition of Alcohol and Ether.

By M. Th. de Saussure.

From M. Cuvier's Report of the Labours of the First Class of the Institute in 1814.

M. Th. de Saussure had maintained, in a memoir on the composition of alcohol and sulphuric acid, that ether is more charged with carbone and hydrogene than alcohol.

He resumed his researches on this subject, and by applying to it processes that were at the same time the most simple and the most accurate, he has arrived at a more precise result.

By passing these two liquids through a tube of incandescent porcelain, he obtained water, and a gas which there was no difficulty in analysing; and he thus discovered that alcohol and ether are each formed of an identical proportion of carbone and hydrogene, and in the same relation in which they exist in the olefiant gas, but combined with different proportions of water reduced to its elements.

In alcohol the elements of the water form a third of the whole, and in ether they form a fifth; so that the action of sulphuric acid upon alcohol to produce ether, consists in taking away a portion of its water; and the same acid, in a larger quantity, produces the olefiant gas, by taking away the whole of the water. These analytical results agree with those obtained by the late Count Rumford on the quantity of heat produced by the combustion of alcohol and ether.

Memoir on the Quantity of Lead necessary in making Assays of Silver of different Alloys: by M. D'ARCET.

From ANNALES DE CHIMIE ET DE PHYSIQUE.

THE art of assaying silver is founded on the small degree of affinity that exists at a high temperature between oxigene and this metal, and on the property of phosphate of lime, when made into cupels, of being penetrated by metallic oxides, held in solution at 10 or 12 degrees of Wedgwood's pyrometer, in the oxides of lead or bismuth in a state of fusion.

These latter oxides, when raised to this temperature, dissolve and carry down the oxidated copper, leaving only the fine silver on the cupel.

The lead * therefore, which is added to the silver intended to be assayed, serves only to destroy the adhesion of the metallic molecules, to favour their oxidation, and to dissolve the oxidated alloy; whence it would seem, that we might deduce this general principle, that the quantity of lead employed for assaying silver, must be encreased in the same ratio as the quantity of alloy; but this is not the case, for experience has shewn, that the quantity of lead must not be augmented in a constant ratio with the alloy that is found in the silver; yet it is very difficult to ascertain the precise quantity; practice alone, and long experience, can give the means of finding the different terms of this proportion. I shall here limit myself to examine the tables of quantities of lead that have hitherto been published, to demonstrate their inaccuracy, and to give the result of the experiments which have served to form the table that is the subject of this memoir.

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* Lead and bismuth can both effect the cupellation, but experience proves that the use of lead is least liable to inconvenience, and we have determined to treat only of this metal.

In 1768 only two quantities of lead were employed; 8 parts for silver above $\frac{590}{1000}$, and 16 parts for silver at an inferior standard. The assayers at that time were acquainted only with the quantities of lead necessary to determine some particular standards of silver; their results were certain when they operated either upon an alloy at $\frac{889}{1000}$, or upon silver below $\frac{500}{1000}$; but they were faulty whenever the assayed silver was alloyed to any other standard: the quantity of lead employed was then always too strong, and the standard indicated was consequently under the real standard.

In blaming this method, however, it must be understood that the inconveniences resulting from it were much less than those that would have been occasioned by using too small a proportion of lead; but still it was not perfect; it was necessary that it should be made so, and this object was undertaken by the Academy of Sciences. The commission which it nominated, after long experiments, published in 1763 the table which is now used by the assayers. To this table I shall add new terms, and shall make some essential corrections in it, which are all indicated by a long series of assays, made with care, and often repeated, both upon alloys of copper and silver, and upon different quantities of these metals, each taken separately.

Messrs. Beyerlé and Arbigny have inserted this table in their work, intituled, "*Elementary Notices on the new System of Weights and Measures,*" and have added a corresponding table, expressing in decimal weights the quantity of lead necessary to refine alloys to such or such standards; but the results of their calculations were very wide of those produced on experiment. Of the eleven terms which the new series contains, only one has been found accurate, and which could, without inconvenience, be carried higher; some of them are too strong, others too weak. The authors have followed the same data as the committee of the Academy; but by inserting between the two extremes a greater number of arithmetical means, they have rendered the mean terms much less accurate: they have ranged on one side the standard of the silver of $\frac{50}{1000}$ in $\frac{50}{1000}$, so as to form a decreasing arithmetical progression, of which the ratio is then always found to be expressed by the number 50. Believing afterwards that in order to make an assay of silver at the standard of $\frac{1000}{1000}$, the first term of the progression, it was necessary to add, after the ordonnance of 1763, two parts of lead; and knowing that in order to assay silver containing a moiety of copper, 16 parts of lead must be used to one of this alloy, Messrs. Beyerlé and d'Arbigny concluded, that by inserting between the extremes of 2 and 16 some mean terms, corresponding with the different standards, they should thus find the proportions of lead necessary for refining them.

It is according to this mode of reasoning that the quantity of lead has been fixed which is deemed necessary for assaying to the different standards between fine silver and silver at $\frac{500}{1000}$.

We may judge from the above observations of the inaccuracy of this method of inserting arithmetical means. The table also of which we have been speaking is almost entirely erroneous; which indeed could not fail to happen, even if the problem could be resolved by the calculation; for the first term of this table formed by the Academy, and which indicates two parts of lead to one of fine silver, being false; the quantity of lead being too strong, as may be seen by the table annexed to this memoir; it ensues that all the rest of the progression partakes of the error; since the ratio being too weak, the terms of the progression are brought too low, and then the assays have not sufficient lead to refine them completely.

If there are any other data extant on this subject, they are either not published, or they are the results of isolated experiments, which all require to be reviewed. I shall now pass to the experiments that have served as bases to the corrections I propose.

Silver at $\frac{1000}{1000}$*, as fine silver contains no alloy, it is evident that the quantity of lead employed with it in the cupel should be as little as possible, and that it must be reduced to the quantity that is only absolutely necessary for the purpose; for we know that pure silver assayed in the cupel never returns to $\frac{1000}{1000}$, and that the loss is greater in proportion to the greater quantity of lead employed. This first term is wanting in the table published in 1763.

I attempted to assay a gramme of pure silver with $\frac{100}{1000}$

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* The cupel furnace which I have used for the assays mentioned in this memoir, has given at an average in most of the experiments, 21 degrees of the pyrometer of Wedgwood in the bottom of the muffle, and 8 degrees at the front, the door being closed.

of lead; but the quantity of lead was too small; this metal became oxidated on the surface of the silver, without entering the cupel; and the heat that was necessary to melt the whole occasioned a great loss. Other assays of the same silver being effected by varying the quantities of lead, have satisfied me that it may be used with more advantage when it is $\frac{3}{10}$ of the mass of silver; we shall therefore consider it to be certain that the assay of fine silver must be done with $\frac{300}{1000}$ of lead.

Silver at $\frac{950}{1000}$. Alloys of 950 parts of fine silver, and 50 of pure copper, were made with different quantities of lead; the examination of these results indicate that this standard requires 3 parts of lead to effect the assay properly: consequently it requires 60 parts of lead to separate one part of copper from the alloy when it exists in it.

Silver at $\frac{900}{1000}$. Different assays made with quantities of lead successively increased, demonstrate that it requires 7 parts of lead to refine one part of silver at $\frac{900}{1000}$: consequently 70 parts of lead are necessary to oxidate and carry down one part of copper in the cupel.

Silver at $\frac{800}{1000}$. I weighed 5 assays, each composed of 800 parts of fine silver and 200 parts of pure copper; I assayed them successively with 8, 9, 10, 11, 12 parts of lead; of these five specimens the third succeeded the best; the button was fine, well crystallized, and at the desired standard. Beyond 10 parts there is too much lead; there is much silver oxidated and carried down in the cupel; with 8 and 9 parts the button becomes spotted.

The quantity of lead necessary for assaying silver to the standard of $\frac{800}{1000}$ is therefore equal to ten times the weight of the quantity taken, which gives 50 parts of lead as necessary for oxidating and separating from the silver one part of copper.

Silver at $\frac{700}{1000}$. The results of 6 assays done by the same process as the preceding, shew that 12 parts of lead are required to refine silver completely to the standard of $\frac{700}{1000}$. This gives 40 parts of lead against one of copper.

Silver at $\frac{600}{1000}$. Several assays, composed of 600 parts of fine silver and 400 of copper, demonstrated that 14 parts of lead are required in this case. In order therefore to assay silver to the standard of $\frac{600}{1000}$, 14 times its weight of lead must be put into the cupel with the quantity to be assayed; the proportion of this metal to the copper being that of 35 to 1.

Silver at $\frac{500}{1000}$. For this standard the experiment proved, that at least 16 parts of lead must be added. The copper in the cupel is then in proportion to the lead as 1 to 32.

Silver below $\frac{500}{1000}$. We here arrive at an astonishing anomaly. Constant experience has long since demonstrated, that the quantity of lead required for the different standards of silver below $\frac{500}{1000}$, is well ascertained, and that no greater quantity is necessary to pass pure copper through the cupel than for cupelling alloyed silver to this standard. We have seen that it requires at least 16 parts of lead to separate and carry down in the cupel the alloy of $\frac{500}{1000}$, which contains silver at the standard of $\frac{500}{1000}$; and experience demonstrates, that the same quantity of lead is sufficient to separate from silver any quantity of copper whatever; so that 16 parts of lead are enough to separate $\frac{999}{1000}$ of copper from a thousandth of silver; which therefore gives, as the proportion of the lead to the copper in the cupel, the expression according to 16,016 : 1.

I have already said, that 16 parts of lead are sufficient to cupel one part of pure copper. If the silver contain half its weight of copper, it then requires as much lead to refine it; that is to say, to separate the $\frac{500}{1000}$ of alloy, which are necessary to cupel $\frac{1000}{1000}$ of this copper; whence it follows, that the quantity of lead employed in refining silver to any standard whatever between $\frac{500}{1000}$ and $\frac{1}{1000}$ is not to be varied, and that it remains constantly fixed at between 16 and 17 times the weight of the quantity to be assayed. How is this phenomenon to be accounted for? the fact is certain; we must attend the explanation from the knowledge of new facts.

By collecting the data established in this memoir, the following table may be formed, and will serve to determine the proportion of lead necessary for refining silver at different standards.

The numbers in the third column indicate how many parts of lead must be added to the assay. If the assay be upon one gramme, and the silver is at the standard of $\frac{900}{1000}$, for instance, it will require 7 grammes of lead to be added, and so on. I have added to the table in the last column, the expression of the relations that exist at each hundred thousandth in the cupel between the copper and the lead. These results of experiment, which do not appear to lead to any general principle, may probably at a future period be usefully applied.

I have not given in the table the variations of standard expressed by hundred thousandths, because between these limits, the intermediate standards relate with sufficient accuracy to the quantities of lead indicated by the calculation; that is to say, we may suppose, without any considerable error, that two standards not differing more than $\frac{100}{1000}$ are proportionable to the quantity of lead corresponding with them.

Thus we may say that if $\frac{800}{1000}$ require 10 parts of lead, 11 parts will be required to refine silver at $\frac{750}{1000}$. This proportion, which is only approximative, is nevertheless sufficiently accurate.

TABLE

Of the Quantities of Lead necessary for assaying Silver.

Standard of the Silver.	Quantity of Copper Alloy in the Silver, according to the corresponding Standards.	Quantity of Lead necessary to refine the Silver.	Relation existing in the Cupel between the Lead and the Copper.
m.			
Silver at 1000	0	$\frac{3}{10}$	0
950	50	3	60 to 1
900	100	7	70 to 1
800	200	10	50 to 1
700	300	12	40 to 1
600	400	14	35 to 1
500	500	from 16 to 17	32 to 1
400	600	from 16 to 17	26,666 to 1
300	700	from 16 to 17	22,857 to 1
200	800	from 16 to 17	20 to 1
100	900	from 16 to 17	17,777 to 1
1	999	from 16 to 17	16,016 to 1
Pure Copper	1000	from 16 to 17	16 to 1

List of Patents for Inventions, &c.

(Continued from Vol. XXVIII. Page 384.)

George Bodley, of Exeter, Iron Founder; for an improved metallic engine, to work either by steam or water, which he denominates "Bodley's improved metallic engine." Dated April 27, 1816.

John Collier, of Windsor Terrace, Middlesex, Engineer; for a machine for shearing woollen cloths. Dated May 1, 1816.

John Rangeley, of Oakwell Hall, near Leeds, Yorkshire, Gentleman; for certain further improvements of his hydropneumatic engine, being a new or improved method of constructing and working engines or machines for lifting or raising of weights, turning machinery of all descriptions, drawing carriages on railways, and capable of being applied to all purposes where mechanical power is required. Dated May 4, 1816.

RICHARD BANKS, of Hadley, in the parish of Wellington, Salop, Engineer; for certain improvements on wheeled carriages. Dated May 4, 1816.

WILLIAM THREADGOLD, of Farm-street, Berkeley-square, Middlesex, Surveyor and Builder; for a machine or apparatus to prevent obstructions to the passage of smoke in and through chimnies. Dated May 4, 1816.

ROBERT COPLAND, of Liverpool, Lancaster, Merchant; for a means of effecting a saving in the consumption of fuel. Dated May 4, 1816.

BENJAMIN ROTCH, late of Castle Hall, Milford Haven, Pembroke, but now of Bath, Somerset, Gentleman, being one of the people called Quakers; for a flexible elastic horse-shoe, for the purpose of allowing the foot of the horse its natural motion when shod. Dated May 11, 1816.

JEAN SAMUEL PAULY, of Knightsbridge, Middlesex; for certain improvements in the construction and use of fire arms. Dated May 14, 1816.

THOMAS RUXTON, of Dublin, Esquire; for a lock for fastening doors, gates, drawers, desks, trunks, boxes, portmanteaus, and other things requiring fastenings, which he conceives will be of great public utility. Dated May 14, 1816.

RICHARD FRANCIS HAWKINS, of Woolwich, Kent, Gentleman; for a method, plan, or principle by which tunnel or tunnels, archway or archways, may be constructed or effected under the river Thames, or other rivers, for the passages of cattle, foot passengers, and other purposes. Dated May 14, 1816.

DANIEL WILSON, of Usher-street, Dublin, Chemist; for certain new and improved apparatus to be employed in the distillation of animal, vegetable, and mineral substances, and in various other processes. May 14, 1816.

WILLIAM SIMMONS, of Wigan, Lancaster, writing master and teacher of accounts; for certain improvements applicable to keyed instruments, as the organ, piano forte, harpsichord, or to any instrument or set of instruments to which keys are, or may, or can be affixed. Dated May 14, 1816.

FRANCIS RICHARDSON, of Queen-street, Westminster, Middlesex, Esquire; for improvements on the locks and barrels of fire arms; and also an improvement or addition to bayonets. Dated May 25, 1816.

PHILIP TAYLOR, of Bromley, Middlesex, Merchant; for a method of applying heat to liquors used in the processes of brewing, distilling, and sugar refining. Dated May 25, 1816.

CHRISTOPH DIHL, of New Bond-street, Middlesex, Esquire; for an improvement or improvements in the making mastic cement or composition, and in the mode of working and applying the same to useful purposes; which cement or composition he denominates "Dihl's Mastic." Dated May 25, 1816.

GEORGE DODGSON, of St. Paul, Shadwell, Middlesex, Pump and Engine Manufacturer; for a method of simplifying and improving the construction of extinguishing engines, and forcing pumps. Dated May 27, 1816.

ISAAC HADLEY REDDELL, of Orange-court, Leicester-square, Middlesex, Engineer; for certain improvements in or on the means of lighting the interior of offices, theatres, buildings, houses, or any place where light may be required. Dated May 27, 1816.

ROBERT KEMP, Junior, of Cork, Smith and Brass

Founder; for an improvement or improvements in the making or manufacturing locks and keys. Dated May 27, 1816.

John Heathcoate, of Loughborough, Leicestershire, Lace Manufacturer; for certain improvements upon a machine or machinery already in use for making hosiery or frame work knitted, commonly called a stocking frame. Dated May 30, 1816.

James Ransome, of Ipswich, Suffolk, Ironmonger; for certain improvements on ploughs. Dated June 1, 1816.

William Shand, of Villiers-street, Strand, Middlesex, artificial limb maker; for certain improvements in the construction of artificial legs and feet, made of leather and wood, acting by a lever and spiral spring. Dated June 1, 1816.

John Foulerton, of Upper Bedford-place, Russell-square, Middlesex, Esquire; for various improvements in beacon buoys, can buoys, nun bun buoys, mooring buoys, and life buoys; which improvements are applicable to other useful purposes. Dated June 11, 1816.

Edward Light, of Foley-place, in the parish of St. Mary-le-bone, Middlesex, professor of music; for certain improvements on the instrument known by the name of the harp lute, which he denominates "The British Lute Harp." June 18, 1816.

John Burnett, of Bristol, Iron Founder; for his convolving iron axletree for the reduction of friction and animal labour, by the application of which, wheels of carriages of every description are prevented from coming off whilst travelling, and carriages are drawn with less animal labour. Dated June 20, 1816.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. CLXXI. SECOND SERIES. August 1816.

Specification of the Patent granted to Thomas Ruxton, *of the City of Dublin, Esquire; for a Lock for fastening Doors, &c.* Dated May 14, 1816.

With a Plate.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said Thomas Ruxton do hereby declare that my said invention is particularly described and ascertained as follows; that is to say: The lock and key about to be described, have, in common with many others, the properties of strength, neatness, durability, lightness, convenience of form and simplicity; they require no knack nor dexterity, they cause no trouble, and they are not apt to get out of order. Among other more important properties which this lock possesses, are these: an attempt to violate it must fail; an attempt to violate it must be detected; it is as little violable by the maker of it as by any other person.

Part the First.—This lock is applicable to every purpose for which the fastening by a lock may be required: for the sake of clearness, let it be supposed that the thing to be secured by this lock is a drawer.

Number 1 of the annexed drawing (see Plate V.) represents the lock, in shape and size, with its cap on. The cap is a plate that protects the interior of the lock. 1, 2, 3, are rivets, by which the cap is fastened to what is called the cheek, and which rivets are part of the cheek. *a b c* are screws that fasten the cap to the main plate of the lock. *s s* is the key-hole. *n* is a spike, technically termed the pipe of the lock, issuing from and fastened to the main plate, and which spike enters into the pipe of the key. A A A A are screw holes: through these the screws are put which fasten the lock to the inside of the front of the drawer. B is the bottom of the bolt of the lock which passes through the cheek.

Number 2 gives a view of the same lock without its cap. 2 is the spike which enters into the pipe of the key. 3 3 is a ward. The two parallel lines below *n*, and apparently connecting the ends of this ward 3 3, are two other wards. The key passes these wards, having apertures (technically termed wards) for this purpose in its bit. The bit of a key is that part which enters into and acts upon and within a lock. These wards are fastened to the main plate of the lock. A A A A are the screw holes through which the screws are put that fasten the lock to the drawer. B is the bolt, which has a cap or metal cover, being a plate that is screwed on by the screw *a*. C is a steel fence, to guard against the effects of any instrument that might be introduced at the key-hole.

Number 16 represents the thickness of the lock. This is the lapped part of the main plate, which lapped part is at right angles with the rest of the main plate, through which lapped part the bolt moves, and which, on opening the drawer, appears on a line and level with the upper edge of the front of the drawer.

Number 3 represents the inside of the lock when the cap of the bolt is removed. This cap, in number 2, conceals from view what here appears. C is a thin flat piece of metal, which I shall call *a tumbler*, turning on a pivot *a*, and acted on by the spring 2, 2. B B is the bolt, the motion of which, up or down, is not hindered by the pivot *a*, nor by the spring 2, 2. 2 is the hole into which the screw goes that secures the cap of the bolt. This screw is seen in number 2, where likewise the cap of the bolt is seen. The pivot *a*, number 3, projects from and is fastened to the main plate of the lock. The upper end of the spring 2 2 is also fastened to the main plate. The bolt B B can move up and down. Its upper part moves through the lapped part of the plate, (that appears in Number 16,) and its bottom moves in the cheek of the lock. The cheek encloses and protects the interior of the lock. After the operation of the locking has been performed, the bolt B B appears as it does in Number 3. In the tumbler C is a slit *n*; and unless this slit be placed under what I shall *the blade r*, which is a part of the bolt, the bolt cannot descend.

In Number 4 is seen the bolt after the operation of unlocking has been performed; and here the blade of the bolt appears in the slit of the tumbler.

Number 5 represents the cap (seen in Number 2) of the bolt, and under it is a separate view, D, of the bottom of this cap, with a dovetail.

Number 8 is a view of the bolt detached from the lock, without a tumbler, and without its cap. At the bottom of the bolt is a dovetail, here visible, into which the dovetail D of the cap of the bolt Number 5 fits.

Number 9 shews the bolt with its cap on.

Number 10 gives a side view of the bolt with its cap on.

Number 11 gives a side view of the bolt without its cap.

Number 15 is a front view of the spring 2, 2, an edge only of which is seen in Numbers 2, 3, and 4. By this view of the spring, Number 15, it is seen that, by means of two slits, its lower extremity is divided into three parts. Each of these three is itself a spring.

Number 17 gives an outer view of the bottom of the lock, as if viewed from beneath. Here is seen the space through which the bottom of the bolt moves in Numbers 1, 2, 3, and 4. 2 is a slanting aperture, through which the cap of the bolt, Number 2, can be removed after the screw *a*, Number 2, is removed. *m*, Number 17, is a projection that forms the rivet 3, in Number 1. Instead of fastening the cap of the bolt by one screw and a dovetail, I sometimes make it without a dovetail, and I secure it by two screws, one at *a*, Number 2, and the other near its lower end, and passing into that part of the bolt which is marked B, Number 1; and in this case the cheek has not the aperture 2, Number 17.

Number 12 is the tumbler C, which appears in Numbers 3 and 4.

Number 13 is another tumbler B; and

Number 14 is a third tumbler A.

These three tumblers are of equal thickness, but their slits *n* are not similarly situated, nor are their tails *d* of equal lengths. The slit of A is nearer to the middle of the tumbler than that of B; and the slit of B is not so remote from the middle as that of C. The tail of A is longer than that of B; and the tail of B is not so short as that of C. These three tumblers are placed on the pivot *a*, Number 3, which pivot passes through their holes 4, seen in Numbers 12, 13, and 14. The tails of the three are concealed from view by the steel fence C, in Number 2. The three tumblers, being on their pivot, are acted on by the spring 2, 2, Number 3, or rather each of them is acted on by one of the three tails which the extremity of 2, 2 forms. The tumblers A and B are concealed from view, in Numbers 3 and 4, by the tumbler C, which is the uppermost one. The tumbler A occupies the position nearest to the main plate on the pivot *a*, Number 3, and is so placed as that its slit is, after the operation of locking has been performed, immediately under the blade *r* of the bolt B B, Number 3; but the slit of the tumbler B is not then immediately under this blade; to be so, it must be moved towards the spring 2, 2; neither is the slit of the tumbler C then under the blade, as appears by Number 3. The edges of the three tumblers, when on their pivot, and when the operation of locking has been performed, present an even smooth surface, perpendicular to the main plate of the lock, for the key to act on in its progress through the lock. In order to perform the operation of unlocking, the key must be so constructed as that it may not disturb the tumbler A in the least, as that it may move the tumbler B towards the spring 2, 2, Number 3, and as that it may move the tumbler C, through a greater space, towards the spring. When the key has moved B and C their respective distances, then, continuing to turn, (but not moving B nor C further,) a part of it enters into the space *s*, Numbers 2, 8, and 9, and the bolt, having now nothing to oppose it, descends, and the operation of unlocking is performed.

Number 23 represents the key, in shape and size, of this lock. On the nose, as it is termed, of this key are projections. This key performs the operations of locking and unlocking, because the projections on its nose are adapted to the tumblers that have been described. The shortest projection on the nose of the key is so short as that it cannot, in the key's progress through the lock, move the tumbler A in the least. The middle projection of the key is just long enough to move the tumbler B its proper distance; and the longest projection of the key is just long enough to move the tumbler C its proper distance.

Number 24 represents the end of this key.

The three tumblers that have been described form the great and peculiar protection of this lock. Their positions on their pivot admit of six variations. Instead of placing them on their pivot in the order that has been mentioned, namely in the order C B A, the maker of the lock might place them in the order C A B, in the order B A C, in the order B C A, in the order A B C, or in the order A C B, and according to the permutation which he might choose he would vary the positions of the projections on the nose of the key. For instance, should the permutation A B C be employed, then the longest projection of the key should occupy the place whence issues, in Number 23, the shortest projection; and the shortest projection should be where the longest one is seen in Number 23. As one of the three tumblers is never to be stirred by the key, two projections on the key would suffice. The third, or shortest projection, in Number 23, might be dispensed with. For greater security, I sometimes place four or more tumblers within the bolt, all on a common pivot, and each having a slit in a different situation. According to the greater or less number of tumblers the key must have a greater or less number of projections, and these projections, each of a length different from the length of every other of them, must be longer or shorter, as the spaces through which the tumblers are to move, in order that the operation of unlocking may be performed, are greater or less. The number of projections may be always fewer by one than the number of tumblers. However numerous may be the tumblers in my lock, I never have more than one of them like tumbler A in the lock here described, which tumbler

A is never to be moved. Each tumbler yields to a moderate pressure, and may be moved by such pressure far beyond its limit. This is an important peculiarity in this lock. On removing the pressure it regains its former position. For greater security, I sometimes make the steel fence C, Number 2, extend round as far as the bolt B. Three tumblers admit, as has been shewn, of six permutations; four would admit of twenty-four; five of one hundred and twenty; six of seven hundred and twenty; seven of five thousand and forty; and eight tumblers would admit of forty thousand three hundred and twenty permutations. The maker, therefore, has it in his power to increase the means of security to any extent at pleasure. But four tumblers, though admitting of only twenty-four permutations, are, in my opinion, sufficient to defeat every attempt at violation.

The person making the attempt must, in order to succeed, first construct a false instrument, that will pass the wards of the lock. Then he must ascertain the number of tumblers, whose edges present, it will be recollected, an even smooth surface to the false instrument. Next, he must find out of the twenty-four permutations (which four tumblers admit) the particular permutation employed. But all this will not suffice. He must, further, ascertain the precise distance to which each of the three tumblers intended to be stirred is to be moved. If any one of these three be moved more, by a hair's-breadth, or be moved less, by a hair's-breadth, than its right distance, or should the fourth tumbler be moved at all, even a hair's-breadth, he cannot succeed. Besides, these discoveries are to be made at a spot which he cannot see, which is much confined; and between which and the key-hole are several impediments. By hair's-breadth I mean a space so small as not to be measurable by the eye. No key made by me will open any lock made by me except its own lock.

Number 29 shews a few of the infinite variety of shapes which my keys are capable of receiving.

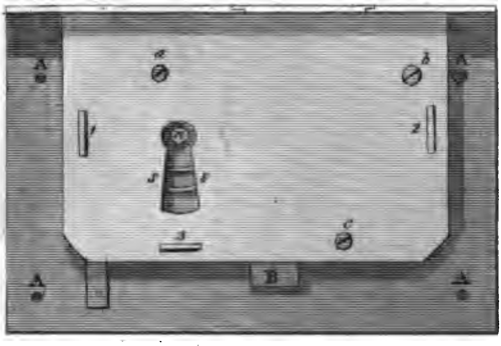
I purpose, that to each purchaser of a lock a drawing of his key be given, so as that another key may be made should the original one be lost.

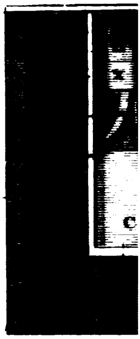
My lock, in its simplest form, is such as I have described it, and in this form, I have to observe, the tumblers may be made without tails. This lock, as I have described it, though simple as a common spring-tumbler lock, I hesitate not to offer to the publick as superior to every other heretofore invented. It is inviolable.

Part the Second.—*An attempt to violate this lock must be detected:* for this purpose I employ the following means. The fence C, Number 2, conceals from view the tails of the tumblers ABC. The same fence prevents their being seen in Numbers 3 and 4, but they appear in Number 33, or rather the tail of C here appears, for under this lie the tails of B and A. The ends *d* of the three tails come close to a small and thin plate of metal, which I call the prop 1, Number 33. The outer edges of the tails touch the cheek 4, 5. Number 19 represents this prop more fully. It has two pivots, 3 and 2, and part of it, *c*, is lower than another part of it, 1. In Number 33 the edge of this prop is seen at 1. Its pivot 2, turns in a piece of metal *ss*, which is rivetted to the main plate of the lock; and its pivot 3 turns in the cheek, 5,4,5, of the lock. On its step or lower part, *c*, Number 19, presses the spring *a b*, Number 33. By means of this step of the prop the end *a* of the spring *a b* is removed from the main plate of the lock. This spring is rivetted to the main plate at its end *b*. The end *b* of this spring appears in Number 1. The cheek is made with a space or cavity

large

N° 1





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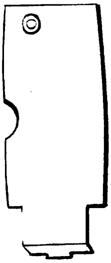

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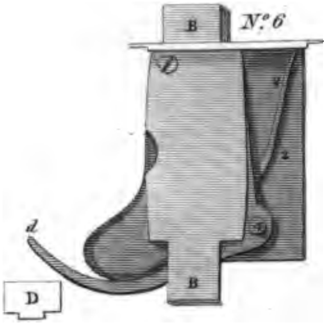

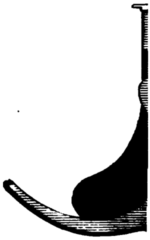

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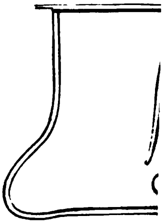

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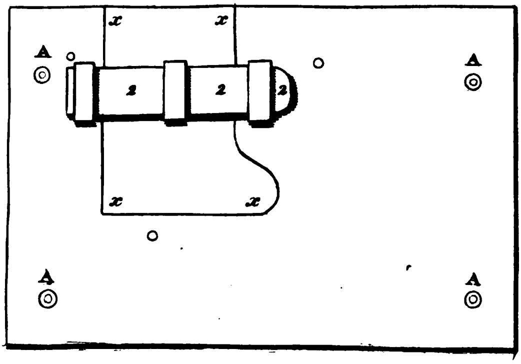

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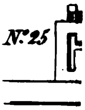

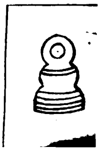

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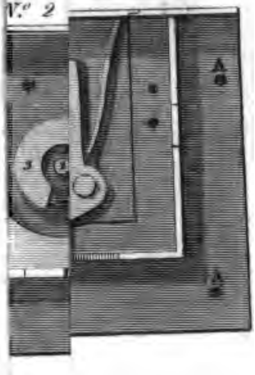
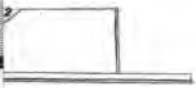
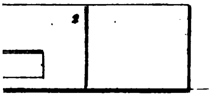
N° 2

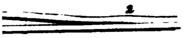


N°15

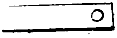
N° 7

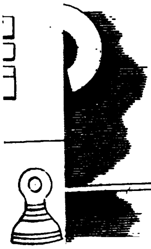






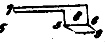
V°20





N°34

N°35



large enough to permit the spring *a b* to act. In other words the cheek does not interfere with it. The prop 1, Number 33, though it turns on pivots, cannot turn *towards* the tails *d* of the tumblers further than to be perpendicular to the main plate of the lock, but it can turn *from* the tumblers so far as to lie flat against the main plate, with its edge, 1, removed from the tumblers. To prevent the prop turning too far towards the tumblers, the spring *a b*, that presses on it, has what I shall term *a shoulder*, against which shoulder the prop rests.

Number 20 represents this spring with its shoulder.

n, Number 33, is the lower termination of what I shall call *the detecting bar*, the only support for which is the spring *a b*. In Number 2 the whole of this detecting bar is seen; it is there marked with the letters *n n n*, and it moves in a piece of metal *x*, riveted to the main plate of the lock. A portion of the upper part of the detecting bar is larger than the rest of it, in order to prevent its passing down too far through *x*, and likewise to prevent its rising too high. Its upper end is, except when violation is attempted, on a line and even with the upper surface of the lapped part of the main plate of the lock; which lapped part is represented in Number 16. In Number 16 *w* marks the spot occupied (except when there is an attempt to violate) by the upper end of the detecting bar. In Number 16 the end of the detecting bar is not to be seen, but only its place. An attempt at violation is to be supposed to have occurred, and such an attempt would cause the detecting bar to fall, as shall presently appear, as far as *x*, Number 2, would permit it. If the prop 1, Number 33, should be pushed or stirred by the tails *d* of the tumblers, or by any one or more of them, it must turn so as to lie flat against the main plate of the lock. The spring *a b* must press upon, that is, lie flat upon the prop, and the detecting bar, losing its only support, must fall down. The lock being screwed to the front of a drawer, the detecting bar is perpendicular to the plane of the horizon, and therefore, losing its support, it must fall.

It was mentioned, in Part the First, that the tails of the tumblers A B C were of different lengths. They are so placed, and the prop 1, Number 3 3, is so placed, as that if the tail of tumbler A should move in the least, if the tail of tumbler B should move in the slightest degree beyond the space through which it would be moved by the action of the legitimate key, or if the tail of the tumbler C should at all exceed the bound to which it would be moved by the operation of unlocking, in any one or more of these three cases, the prop would be pressed upwards, the spring *a b* would press it so as to make it lie closely to the main plate of the lock, and the detecting bar, wanting the support of the spring, which would have followed the prop, would fall, leaving to the view of the proprietor of the lock, when he should next open his drawer, a hole in the upper part of the lock, as in Number 16; which hole, had there been no attempt at violation, would be filled to its upper edge with the detecting bar.

The key, in performing the operation of unlocking, sends the ends of the tails of the tumblers B and C, as far as the end of the tail of the tumbler A, (which at all times is to be stationary,) so that in this operation all the tails are within a hair's-breadth of the prop 1, Number 3 3, but in this operation none of these tails can touch it. A false key, that should stir the tumbler A in the least, or should move B a hair's-breadth more than its due distance, or C a hair's-breadth more than its proper path, would cause the prop to be touched, and therefore would move the prop so as to make it lie closely to the main plate of the lock, and with the prop the spring *a b*, which would lie flat upon the prop. The detecting bar would then fall, having no support, and thus an attempt to violate would be indicated.

Number 18 gives a side view of this spring, the prop, and the detecting bar. 1, 2, is the spring, *s* is the prop, and *n n* is the detecting bar, which moves through *x*. A portion is visible of the lapped part of the plate of the lock, through which lapped part the detecting bar *n n* moves.

To obtain a purchase (to use a technical term) on the prop, I sometimes make a little chamber in the main plate of the lock, and in this chamber I cause the prop to turn on its pivots, in order that the pivots may be further removed from the ends of the tails of the tumblers, than the pivots are, according to the annexed drawing. I sometimes give to the end of the tail of each tumbler the shape represented in Number 34. When I make the ends of the tails of the tumblers of this shape, I place, nearly on a line with the prop, and between it and the rim of the steel fence C, which fence is seen in Numbers 2, 3, and 4, a small thin plate of metal, which I shall call *a lever*, Number 35. It is bent so as to be at right angles at 5, 6. At 5 it has a pivot, which plays in *s s*, Number 33, and at 6 it has a pivot which plays in the steel fence. This lever is so placed, as that the end of the branch 2, Number 34, of the tumbler, comes closely to its lower part 9, Number 35, which part 9 is perpendicular to the main plate of the lock. The end 7 of this lever is behind the lower end of the detecting bar.

When this addition to the detecting apparatus is employed, the detecting bar is made so as that a small portion of its lower end rests on the prop, which cannot be made to lie flat against the main plate unless it be disengaged from this small portion (of the detecting bar) that rests on it. When I employ this addition to the detecting apparatus I attach to the lower end of the detecting bar a weak spring, that presses gently against, or rather touches, the inside of the cap of the lock. When this addition to the detecting apparatus is adopted, the detecting bar cannot descend unless each of two things happen; that is, unless the prop be pressed upwards, by one or more of the tumblers' tails, and unless the lower end of the detecting bar be moved so near to the cap of the lock as that its lower end will be disengaged from the prop. If these two things should happen simultaneously the detecting bar will fall, and not otherwise. But they will happen simultaneously or not at all; because, should a tumbler press the prop by its termination 1, Number 34, it must of necessity by its branch 2, Number 34, move the part 9 of the lever 5, 6, 7, 8, 9, Number 35, and the part 9 of the lever being thus pressed, its other part, 7, 8, will be removed further from the main plate of the lock, inasmuch as the lever turns on the pivot 5, 6, which pivot is parallel to the main plate, and also horizontal. If 7, 8, be thus removed, the detecting bar will by it be removed from its rest on the prop. If the tail of any one of the tumblers should press the prop, the lever at the same time must remove the lower end of the detecting bar from its rest on the prop, by placing it nearer to the cap of the lock. The detecting bar cannot fall unless the spring *a b*, Number 33, be removed; the spring *a b* cannot be removed unless the prop on which it rests be removed, and the prop cannot be removed unless the detecting bar be removed. Now all this is done by the slightest impulse of any one of the tails of the tumblers, but the legitimate key can never produce such an impulse. A false key will.

In order to facilitate the re-adjustment of the detecting

ing apparatus, after an attempt to violate, I sometimes make a part of the main plate of the lock moveable, up and down, in grooves; which moveable part, when withdrawn, brings with it the detecting bar, the prop, and the lever, if there be a lever. This moveable part is kept steady by a bolt, like that represented in Number 21, and, like the bolt in Number 21, this bolt is on the outer part of the main plate of the lock.

The simplicity of the lock is not affected by this apparatus for betraying clandestine efforts to open it, the operations of locking and unlocking being quite independent of such apparatus, and therefore the lock may be considered to be independent of it.

Number 30 represents in shape and size a padlock, made on the foregoing principles. The dotted line 2, 4, is that part which, by turning on a pivot at 2, can be made to embrace part of the thing to be fastened, and which part so turning is technically termed the shekel. The dotted part 4 goes into the body of the lock at an opening at 3, and there is a hole at 4 to receive the bolt of the lock when the part 4 is introduced into the lock. The drawing likewise represents the shekel, as it would appear when the lock was locked. 1 is the key-hole.

Number 31 is another view of this padlock. An attempt at violation causes a bar to descend, which is not here visible. If this bar should lose the support of a spring and a prop within the padlock, and which spring and prop resemble *a b* and 1, Number 3 3, it, that is the detecting bar, falls into the lock as far as 5, leaving visible a hole (which were there no attempt at violation would not be) in a part of the lock under the shekel, and near to the pivot 3. An attempt to violate this padlock will therefore be discovered.

The indication of an attempt to violate this lock, when securing a cup-board or a gate, (in which situations the bolt moves horizontally,) is produced by the bar *n n n*, Number 2, falling, not perpendicularly but obliquely, into the lock, leaving visible a cavity in that part of the lock which is level with the edge of the door or gate, and which cavity can never appear unless violation be attempted.

Part the Third.—*This lock is as little violable by the maker of it as by any other person.* To this end I make certain parts of the lock and the key moveable.

Number 21 represents the outside of the main plate of the lock. A A A A are the holes through which it is fastened on the drawer. 2, 2, 2, is a bolt, on withdrawing which, a part, *x x x*, may be withdrawn. An inner view of this moveable part is given in Number 6.

Number 22 is a view of the inside of this moveable part without bolt or tumbler. Along with this moveable part, Number 6, there are removed the bolt B B, the spring 2, 2, and the tumblers on their common pivot 4. The tails *d* only of the tumblers can be seen here.

Number 7 is another view of the inside of this moveable part, and in this view, the cap of the bolt being removed, the whole of the tumbler C appears.

Number 6 represents the bolt as it would appear after the operation of locking; Number 7 as it would appear after the operation of unlocking.

In Number 16, 2, 2, represents the upper part of this moveable piece. This moveable piece fits nicely in rabbets in the main plate of the lock; and by means of these rabbets and the bolt 2, 2, 2, Number 21, it is as firm as any other part of the lock. The moveable part being withdrawn, and the cap being removed from the bolt, the tumblers can be taken off from their pivot 4, Number 7, and shifted into new variations of positions.

To prevent the action of the spring 2, 2, while shifting the tumblers, there is a small hole in the main plate of the lock, into which hole, a pin being inserted, the spring is restrained from its action, and thus the tumblers may without difficulty be removed and shifted. That part of the pivot 4, Number 7, on which the three tumblers turn, is divided into three portions, marked 1, 2, 3. The portion nearest to the main plate of the lock is marked with 1, and the portion furthest from the main plate with three; the middle portion is marked with 2. A permutation being chosen for the tumblers, and they placed accordingly, the cap of the bolt being restored, so as to make the inside of the moveable part resemble Number 6, and the moveable part being put in its place, and secured by the bolt 2, 2, 2, Number 21, the key is to be adapted to the chosen change.

Number 25 is a view of the key fit for a choice of permutations of tumblers. B C are projections on its nose, and on the side of its bit are the figures 1, 2, 3.

Number 26 is a view of the end of this key; 2 is a dovetail. Those parts of the bit which are not occupied by the projections C B are the parts of the key which touch and act on the plate, and the cap of the bolt in the operations of locking and unlocking. The part of the bit next to the projection C acts on the plate of the bolt, and the part of the bit next B acts on the cap of the bolt. The projections B C on the key, Number 25, are moveable.

Number 27 is a view of the projection C of Number 25. This projection, as well as the projection B, has a dovetail, which fits into the dovetail 2, of Number 26.

Number 28 is a side view of the projection C. The dovetail in the nose of the key extends no further than where the projection C is placed in Number 25. The projections B C on the key, Number 25, can be removed from the key, or put upon it, at pleasure; and their positions on the nose of the key can be always varied. At present the projection C occupies the position 3 of the key, because the tumbler C occupies the position 3 on the pivot in the lock, and the projection B of the key occupies the position 2 of the key, because the tumbler B occupies the position 2 on the pivot. There is no projection from the position 1 of the key, Number 25, because the tumbler A, which occupies the position 1 of the pivot, is not to be stirred at all; and any projection on the position 1 of the key would have the effect of stirring the tumbler A. When the projections are placed in their proper stations on the key, they are secured by a screw, the head of which appears in Number 25. These moveable projections of the key are as steady and as strong as any other part of the key. Thus the key and the lock, however numerous the projections and tumblers, can always be varied, and always be made to correspond.

By adopting a new permutation of projections on the key, and a corresponding permutation of tumblers, this lock is not violable by its maker.

Number 31 represents a padlock made on these principles. The part 1, when the padlock is unlocked, when the bolt x is withdrawn, and when a screw, that appears in Number 31, is removed, can be turned on a hinge at 6, and being turned over so far as that 2 reaches 7, any desired permutation of tumblers may be made, they and their spring, and the bolt of the lock, being fastened to and turning out with the part 1.

The part 1 being restored to its place, in which place it is kept fast by a screw and the bolt x, its end 2 presents a hole for the part 4 of the padlock to enter into when the operation of locking is to be performed: and thus, not only is the padlock locked, but the part 1 is by the same operation likewise locked, the bolt of the padlock passing through 4, and also through the end 2 of the moveable part 1.

Number 32 gives a side view of this padlock.

Part the Fourth.—The thing to be secured by a lock is often so ill finished, or so ill constructed, as that the bolt securing it is accessible to a file or a saw, or to a corrosive substance. To guard against these dangers, I sometimes make my bolt of steel, and I insert into it one or more pieces of flint, (enveloped with a thin coating of lead to resist fluoric acid,) or I insert into it one or more pieces of Wedgwood's porcelain, such as that of which mortars and pestles are made.

Part the Fifth.—In order further to deter from any attempt at violation of this lock, I sometimes construct it so as that such an attempt must produce an alarming noise. This is effected by the action of the spring *a b*, Number 33, when it is disengaged, which can only happen on an attempt to violate. The noise is made by a rattle, a clapper, a plate of metal striking a flat board, a bell, or by condensed air (within a tube) bursting a leather cover of this tube, which cover is protected from such disruption by a metal cap, but only so protected until the action of the spring *a b*, Number 33, may happen to remove this cap.

Here I shall observe, that, according to the principles already explained, an attempt to violate this lock will always afford a moving power, by which many objects may be effected.

Part the Sixth.—I sometimes construct this lock so as that an attempt to violate it causes to be exhibited an indication that such an attempt was made to every person who may chance to look at the thing secured, as, for instance, a drawer. This is effected by the disengagement of the spring *a b*, Number 33, letting fall a bar within the lock, the end of which bar is, until an attempt to violate be made, on a level with the outer surface of the front of the drawer, but, falling, a cavity appears in the front of the drawer.

PART THE SEVENTH.—I sometimes construct this lock so as that, where local situation does not forbid, the person making the attempt will, without sustaining personal injury, be caught and detained. The means by which this is effected I think it better not to publish.

PART THE EIGHTH.—I sometimes construct this lock so as that an attempt to violate it must cause the false instrument used in the attempt to be detained. When this effect is produced the lock becomes unopenable by any means, even by its legitimate key, and recourse must be had to the sledge, the saw, or the chisel. Such being its character, an attempt to violate this lock will seldom be made; but this effect will not be produced till after a continued, dexterous, and determined effort at violation. If inviolability is the first object in the formation of a lock, the more serious, the more terrible, the consequences of an attempt to violate it are made, the better. I produce this effect thus: when the spring *a b*, Number 33, is disengaged by an attempt at violation, it releases a spring that throws out of the main plate of the lock a piece of steel into the lock, which piece of steel when thrown out occupies the space through which only the false instrument employed to violate could return to the key-hole.

PART THE NINTH.—I sometimes construct the key for this lock so as that, if lost or carelessly kept, a person finding or procuring it shall not be able to perform the operation of unlocking. This object is attained thus: in some spot of the nose of the key, from which should issue no projection, I insert a mock projection, so contrived as to be removeable in a moment, and without trouble.

Part the Tenth. — I sometimes construct this lock and its key in such a manner as to obviate the danger which might arise from the key being negligently left in the key-hole after the operation of locking. This end is attained by having within the pipe of the key a spike, one end of which passes out into the handle (or, as it is technically termed, the bow) of the key. The spike of the lock which enters into the pipe of the key is, when the lock is to be opened, pressed by the spike in the pipe of the key a certain distance, known to the proprietor of the lock, and which distance is indicated to him by a weak spring, on the spike in the pipe, pressing into a notch in the shank of the key. In performing the operation of unlocking, the end of the spike which enters the bow, is to be pressed by the finger until the weak spring enters the notch. The pressure continued further would hinder the operation of unlocking. With the spike of the lock is connected a bar, at the end of which is a projection. In order to permit the key to reach the bolt, the projection at the end of this bar must be sunk within the main plate of the lock. This is only to be effected by pressing the spike in the key to its proper distance. To do this a knack, acquirable by some practice, is requisite. Should the spike of the lock be pressed too much, it would throw out of the main plate an impediment to the progress of the key.

Conclusion.—All the properties described in the second, fifth, sixth, seventh, and eighth parts of this specification, depend on mechanism, which adds no complexity to the lock properly so called, every part of this mechanism being dormant, unless brought into action by an attempt at violation. It may be proper, however, to state, that the locks which I employ for my own use have no properties and no parts, save those described in the first, second, third, and fourth parts of this specification. I have contrived means to produce the effects, and to yield the properties described in the other six parts, in order to gratify as great a variety of tastes as possible.

A purchaser can obtain a lock, large or small, for the fastening of any thing which may be fastened by a lock, simply as it is described in part the first, or he can procure one possessing further the properties described in the other nine parts, or in any one or more of these nine parts.

This lock deters from attempts at violation. It not only secures property, but it prevents crimes. It merits therefore, perhaps, some attention. I have presumed to call it the *Inviolable Perfect Lock.*

In witness whereof, &c.

Specification of the Patent granted to WILLIAM EVETTS SHEFFIELD, *of the Polygon, Somers Town, in the County of Middlesex; for divers Improvements in the working or manufacturing Copper and its Compounds, and other metallic Substances, or any or either of the same.* Dated September 23, 1814.

With an Engraving.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said William Evetts Sheffield do hereby declare that the nature of my said invention, and manner of performing the same, are particularly described and ascertained in manner following; that is to say: My first improvement doth consist in the working or manufacturing copper and its compounds, containing chiefly, or for the most or greater part, copper along with other metals, by subjecting the same copper or its compounds to the process of cementation by heat, in a closed vessel or furnace, along with charcoal of wood, fossil coal, charred or animal coal, or any other substance, consisting for the most part or proportion of coaly matter, but in general I give the preference to the charcoal of wood. And that, with regard to the subdivision of the parts and enlargement of the surfaces of the said copper or its compounds, whether by granulation or otherwise, and also the management and application of the heat, I do conduct my process according to and in like manner as the well-known processes of technical and philosophical chemistry, relating to cementation, which are generally practised and understood.

And I do hereby declare, that the effect of my said process of cementation upon copper, and the compounds thereof, as aforesaid, according to the extent to which the operator may be required or disposed to carry the same, is either that the copper becomes more completely reduced or deprived of oxygen, or that a portion of carbonaceous or coaly matter does probably or may become actually united or combined with the copper or its compounds as aforesaid; but that the copper or its compounds as aforesaid do by such treatment become better in quality for various uses, and in particular for making a very superior brass, by uniting the same with good zinc, either by direct mixture or by using calamine, or other fit ore of zinc.

And, farther, that in my said process of cementation I do in preference use a degree of heat somewhat greater than is fit, and used for annealing of copper; or otherwise I do carry my heat as far as that of fusion; and that I do consider my copper, or the compounds thereof as aforesaid, to be sufficiently and well cemented when the surface thereof (examined by a magnifier if necessary) does present a striated or dotted form, structure, or appearance, very considerably resembling that of the skin of the tip or inner extremity of the finger.

And I the said William Evetts Sheffield do hereby farther declare, that the second improvement, comprehended in my said invention, doth consist in the working or manufacturing copper and its compounds, and other metallic substances, or any or either of the same, into sound and perfect wire, provided the said copper and its compounds, or other metallic substances, or any or either of the same, be of such nature as to admit of being wire drawn; and for the said purpose I do form my metal into plates, as shewn at A, Fig. 1, (Plate VI.) in the drawing hereunto annexed, and do afterwards, by means of cutting and rounding cylinders, of the nature or description shewn at D, having edges opposite, or very nearly opposite, each other, with the usual supports and adjustments for regulating the distance thereof, divide, or very nearly divide, the said metal into round or rounded pieces, without producing any flexure, or over-lapping of the edges, (such as are produced in the common way of making wire, and do render the same hollow and unsound); and I do afterwards, if need be, complete the division, by separating the parallel pieces by any ordinary means. And in case there should be a small portion or fin left upon the surface of the metal, I do cut off the same by a fit tool or implement, and do then proceed to draw down my metal into wire of the size required to be made.

And, lastly, in the said drawings the letter B denotes (by a section) the metallic plate, partly notched or cut by the cylinders set at one of the distances by adjustment; and letter C denotes (by a like section) the same plate cut through, or very nearly through, by the cylinders set close together, or nearly so, and to be afterwards, if need be, separated by any ordinary means; and E represents, by a section, a plate, or piece of steel or metal, having a steel piece at *g*, at the mouth of the hole *g h*, and in either case the steel mouth at *g* is formed, by external chamfer, into an edge, and is used to cut off the small portion or fin from the surface of the metal as aforesaid, by drawing it through the said hole.

And, lastly, although said drawings are made to certain relative dimensions, as to the parts thereof, I do nevertheless declare, that the same will require to be altered and used according to the size of the wire, the nature of the work, and other circumstances, which every fit workman, in work of this or the like nature, will readily understand.

In witness whereof, &c.

Specification of the Patent granted to WILLIAM WOOD, *of Shadwell, in the County of Middlesex; for the Manufacture of a Material or Materials, and the Application thereof, to the more effectually making water-tight and sea-worthy Ships, and all other Vessels.*

Dated March 9, 1815.

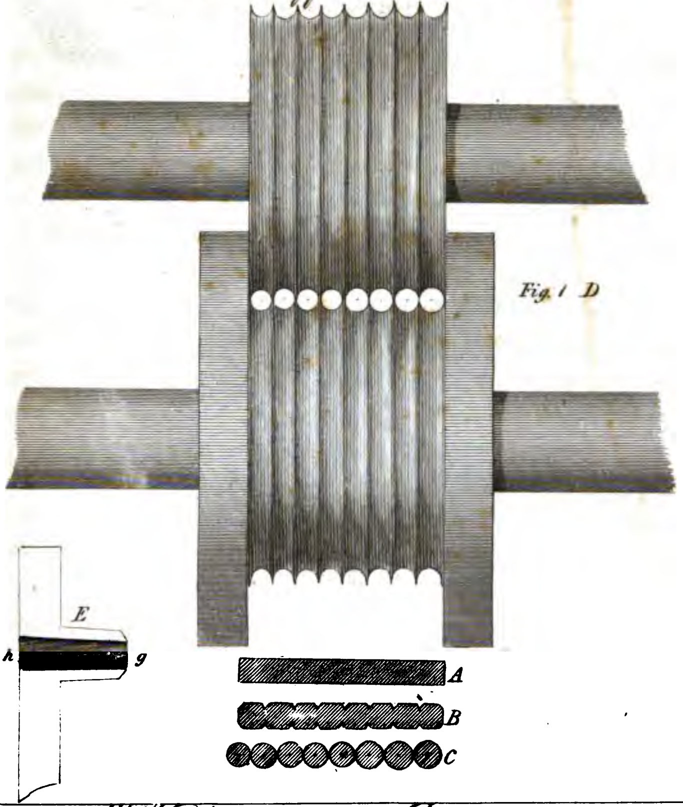
With an Engraving.

TO all to whom these presents shall come, &c. NOW KNOW YE, that I the said William Wood, in compliance with the said proviso, do hereby specify, describe, and ascertain the nature of my invention, and do declare that the same is to be performed in manner following;

that is to say: My invention consists in the application of sheets or flat pieces of felt, manufactured and prepared according to the hereinafter-contained description, to ships and other vessels, for the purpose of preventing leakage, and so to effect the better preservation of the said ship and other vessels, and the good condition of their cargoes. I do declare, that for these purposes I take hair, wool, cotton, or other materials which have the property of felting, which I manufacture into sheets or pieces of the size of about three feet in length, by a width of about sixteen inches, which is the size I find in practice the most convenient to apply to the object to be covered with these sheets. In the choice of materials I use wool or hair, either by themselves or mixed with each other, or with cotton, or any material fit for the purpose, in such proportions as experiment shall determine necessary to produce a compound which will felt properly. Thus, if I wish to make a sheet of twelve ounces weight, and I find on trial with equal quantities of hair, wool, or cotton sheet, the mixture does not felt readily, then I add wool to the compound, in small quantities, as, for instance, of two ounces at each experiment, taking away an equal weight of the material already mixed, at each addition of the wool, until I find the whole mixture felt properly and easily. It is only necessary to make this experiment on the relative proportions of the materials at the first use of a fresh purchase of materials, or an untried parcel of materials. The due proportions of the mixture, if any mixture is required, being duly ascertained, I take the quantity I mean to use in the sheet, according to its intended dimensions, and bow it finely, according to the methods well known and practised in heat matting. I gather the materials thus bowed, and arrange them in the figure of the sheet

I wish

Mr. Sheffield's Patent.



Mr. Wood's Patent.

Fig. 2.

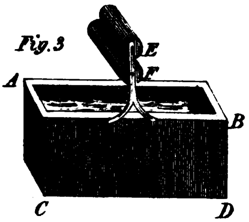


Fig. 3

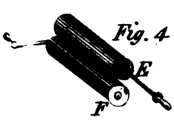


Fig. 4

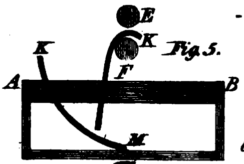
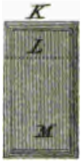


Fig. 5.



belonging to Fig. 5.

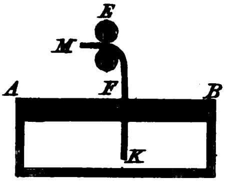


Fig. 6.

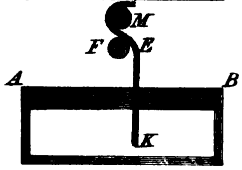


Fig. 7.

UNIV. OF

I wish to make with a piece of basket work, with which the workman lays the materials together more lightly and uniformly than he could do with the hands. Sheets of the dimensions of three feet by one foot four inches are made of about half an inch in thickness, more or less, except about an inch in width from each edge, through which width the thickness gradually diminishes to the outer edges, as in Fig. 2 (Plate VI.) of the explanatory drawing, which represents the cross section of a sheet A B, the thickness of a sheet C D, and D E, the two outer edges gradually diminishing in thickness to the edges C and E, the width of this gradually diminishing of the thickness of a sheet will depend on the dimensions of the sheet; it will generally be from one inch and a half to three inches. The materials of the sheet being thus laid ready for felting, a straight edge is applied to each edge, and the sheet trimmed or cropped to its proper dimensions with the finger and thumb, when the sheet has, by pressure with the basket, acquired sufficient consistency to bear folding, it is folded in a wet cloth, such as is known in hat making by the appellation of the basin cloth, and is then laid upon a hot iron plate. When it is worked gently with the hands, after the known practice of felting among hat-makers, for about ten or fifteen minutes; the cloth is then unfolded, and if the felting is sufficiently advanced for the sheet to bear folding up, any thin or defective parts are then made good by the addition of fresh materials, and the felting process is continued till the sheet has acquired sufficient hardness and firmness to hold well and completely together.

In the process of felting I use the usual and well-known practice of hat-makers; and I fold one or more sheets in the basin cloth at one time. I bow and felt either by hand, or with the assistance of such machinery as hat-makers in general do, or may avail themselves of, for those purposes, according to the scale of the operation. The sheets being thus folded and formed, are then ready for the final process of tarring, which I perform in manner following. I take Stockholm tar, Archangel tar, coal tar, or any other tar, but in practice I prefer thick Stockholm tar; to every barrel of which I add about half a hundred weight of pitch, but which mixture is discretionary. I then heat the tar, or the compound of tar and pitch aforesaid, to a convenient and sufficient fluidity to the weather, and the natural consistency of the tar. I then add about one quart of oil to every barrel of the tar, or compound of the tar and pitch, if any other mixture is required, such as brimstone, arsenic, or any other preventative for worms. I apply them, and I then proceed to dip the sheets of felt in the mixture. This operation I perform in the following manner. A cistern, kettle, vat, or any other suitable vessel, of an oblong shape, or any other convenient or suitable shape, contains the mixture as the vessel A B C D, Fig. 3, in my explanatory drawing, over which I place two cylindrical or other suitably figured rollers E and F, which are supported by any convenient and proper frame-work, suitable to their size and weight, and they are made to revolve each in a contrary direction to the other, by having a toothed wheel or pinion set on the end of each; and one of them, as E, being worked by a winch, the pinions working into each other, the lower roller F will revolve on a contrary direction to the upper roller E, which is turned by the winch, or each roller may have a winch, as in Fig. 4, by which two men may turn them in opposite directions. The rollers are hollow, and are moderately heated, either by iron heaters, which are applied within them, or by the introduction or passage of steam, at a sufficient temperature,

ture, or by any other convenient and sufficient mode of supplying heat which may suit the state of the machinery and operations. A man stands at the end A of the vat or vessel containing the mixture, see Fig. 5. He takes a sheet of felt, K L M, and holding it in both hands, by the upper edge of one of the shorter sides, as K, he dips it in the kettle, as shewn by the dotted line K L M, as far as the line L. He then presents the end K, which yet remains undipt, to the rollers, and introduces it between them, as in the figure. The rollers are then worked by any of the afore-described methods, in the direction indicated by the darts, marked on their ends in the figure, until the end K of the sheet of felt has descended so far into the mixture that the portion of it which was left undipt by the workman at A has descended into the mixture, and is dipt, as in Fig. 6. The motion of the rollers is now stopped, and the workman at A turns the end M of the felt over the upper roller E, as in Fig. 6. The assistant at B holds the end M, which is now turned towards him, and the rollers are worked in the opposite direction, as is indicated by the darts marked in their ends in Fig. 7. The sheet of felt will now be gradually released from the rollers, the workman at B still holding the end M, and he takes it from the vat completed. The space between the rollers which regulate their pressure on the sheet of felt, and also the quantity of the mixture which is expressed from the sheet, is adjusted and preserved by levers and weights, or by any of the obvious and suitable methods known to mechanics for adjusting the pressure of rollers.

I further declare, that I apply my said invention, manufactured and produced as aforesaid, in manner following; that is to say: The bottoms and sides, or those parts of the ship or vessel to which the sheets of felt are to be applied singly, are first payed over with tar, or a mixture of tar and pitch, or other adhesive and proper material of that nature, according to the known practice of shipwrights; and the sheets of felt are then placed singly and in succession upon the parts required to be protected by them, due care being taken to overlap the same and ends, and the same is then held or fastened on by proper nails. In applying the sheets of felt singly, and in succession to each other, the edges and end of those already fixed are to be payed over with the materials already used. In paying the surface on which the sheet of felt is applied, and when the sheets are placed and fixed as aforesaid, the joinings must be carefully payed over again with the same materials before used. In paying I also apply the felted sheets previous to their being tarred, by applying tar or mixed stuff to the ship or vessel, the part being prepared as before described, and raising the said felted sheet thereon, in the same way as above described; and afterwards I apply the said tar or mixed stuff to the outside by the usual means, but I prefer the before-mentioned method of preparing the felt, and applying the said mixtures. The adhesion of the sheets of felt to the parts to which they are applied may be further secured by a covering of thin plank or copper sheeting, or by any other of the obvious and suitable methods known and practised by shipwrights. When in covering a surface it is found necessary to cut a sheet of felt into any smaller pieces, the cut edges, which will then be thick, must be reduced to a sloping edge by a knife, or other suitable instrument. Sheets or pieces of felt may beneficially be cut into narrow strips, for the purpose of filling in seams, or other hollow or vacant parts.

I further declare, that I claim only as my invention the production of the aforesaid sheets or pieces of fitted materials,

terials, manufactured and prepared as aforesaid, for the purpose of applying them to the bottoms and other parts of ships and other vessels, for the prevention of leakage, as aforesaid. I claim the substance produced as in its finished state, and its application as aforesaid, and not any part of the process by which it is or may be produced.

And I further declare, that the herein-contained descriptions of process are set down by me for the sole purpose of explaining the nature of the substance produced, and the most simple manner of producing it, intending to avail myself, in my processes of production, of all such devices and machinery known and practised by hatmakers and others as I lawfully may, or, according to the state of my operations, I may from time to time judge necessary and suitable.

In witness whereof, &c.

Specification of the Patent granted to ROBERT DICKINSON, *of Great Queen-street, in the County of Middlesex, Esquire; for a certain Improvement or Improvements in the Manufacture of Barrels and other Packages made of Iron and other Metals.* Dated December 10, 1815.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Robert Dickinson do hereby declare, that the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained in manner following: that is to say; Within each end of the barrel made of iron, or any other metal, I place an iron hoop, so formed that it shall, for about one half of its breadth, be in contact with the inside

side of the barrel, the other half receding inwards a little way, and then going in the direction of the side, so as to form a recess or groove to receive into it the edge of the piece which forms the top or bottom. The said piece being formed of a diameter somewhat greater than that of the barrel, and having its edge all round turned up at a right angle, or nearly so, to the plane of the top or bottom, commonly called the head, (somewhat like the lid of a common circular tin snuff-box,) in such manner that the diameter of the flat part shall be such as to go within the edge of the cask or barrel, the turned up edge or rim going into the foresaid recess or groove. In which recess or groove is previously introduced, with any proper soft cement, a filleting of hemp, cotton, or any yielding substance fit for the purpose; that the said turned up edge or rim, when pressed home against it, may form a joint sufficiently close to retain fluids of any kind intended to be put in the cask. The top and bottom are then pressed home into their respective recesses; they are kept in their places by a hoop of iron, of a breadth equal to the chime intended to be given to the barrel, fitted into each end of the barrel, pressed home against the head and bottom; another fillet of hemp, or any fit subsance, being previously put in all round under the said hoop, with some proper cement, still more effectually to make a safe tight joint. When the top and bottom, with such hoop on the outside of each respectively, are pressed home to their proper bearing, the said hoop is secured on its place by pins passed through the said internal hoop, through the side of the cask, and through an outside hoop, one outside hoop being put on at each end to give still more strength to the chimes the said pins being either screwed in or secured in their places by rivetting. The said outside hoops may be made of flat hoop iron, in the usual way in which iron hoops are made; but I prefer hoop iron, rolled for the purpose, of such a form as would be exhibited by the remains, if a cylindrical rod of two-thirds, or three-fourths have been taken away longitudinally. By adopting this form, the hoop, though left flat within, to embrace the surface of the cask, is rounded in its breadth without, somewhat like a common wooden hoop, so that being narrower in breadth, or thicker in the middle, than a common hoop of the same weight and diameter, it presents less surface for the destructive effects of oxydation or rusting than a hoop made in the usual form, and consequently will last much longer. I also furnish the iron barrels with a metal valve, so constructed as to open outward by the internal pressure produced by the expanding of the contained fluid when its temperature happens by any means to be raised higher than at the time when it was introduced. In the mere construction of the valve I claim no originality of invention, as any construction fitted to act well in the manner stated, and to allow a part of the contents to escape when expanded, will answer the purpose; but the application of a valve to casks or barrels destined to contain tar, oil, varnish, and other liquids, which by their expansion in warm climates, or by heat generated in any way in the holds of ships, often burst the vessel intended to preserve them, is, I believe, new.

In witness whereof, &c.

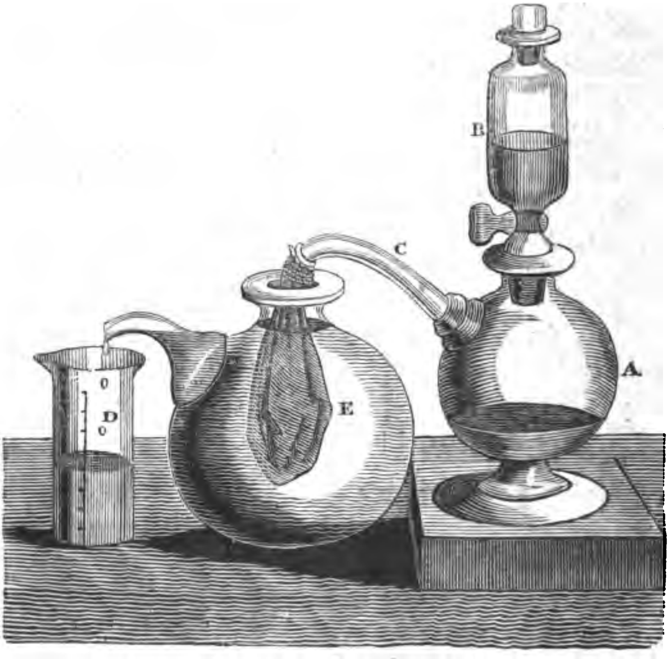
On Soils: their constituent Parts. On the Analysis of Soils. Of the Uses of the Soil. Of the Rocks and Strata found beneath Soils. Of the Improvement of Soil.

By Sir HUMPHRY DAVY, LL.D. F.R.S. L.& E., &c.

With a Wood Engraving.

(Continued from Page 105.)

THE best method of collecting the carbonic acid, so as to discover its volume, is by a peculiar pneumatic apparatus, in which its bulk may be measured by the quantity of water it displaces.



A B C D represent the different parts of this apparatus. A, represents the bottle for receiving the soil. B, the bottle containing the acid, furnished with a stop-cock. C, the tube connected with a flaccid bladder. D, the graduated measure. E, the bottle for containing the bladder. When this instrument is used, a given quantity of soil is introduced into A. B is filled with muriatic acid, diluted with an equal quantity of water; and the stop-cock being closed, is connected with the upper orifice of A, which is ground to receive it. The tube D is introduced into the lower orifice of A, and the bladder connected with it placed in its flaccid state into E, which is filled with water. The graduated measure is placed under the tube of E. When the stop-cock of B is turned, the acid flows into A, and acts upon the soil; the elastic fluid generated passes through C into the bladder, and displaces a quantity of water in E equal to it in bulk, and this water flows through the tube into the graduated measure, and gives by its volume the indication of the proportion of carbonic acid disengaged from the soil; for every ounce measure of which two grains of carbonate of lime may be estimated.

6. After the calcareous parts of the soil have been acted upon by muriatic acid, the next process is to ascertain the quantity of finely-divided insoluble animal and vegetable matter that it contains.

This may be done with sufficient precision, by strongly igniting it in a crucible over a common fire till no blackness remains in the mass. It should be often stirred with a metallic rod, so as to expose new surfaces continually to the air; the loss of weight that it undergoes denotes the quantity of the substance that it contains destructible by fire and air.

It is not possible, without very refined and difficult experiments, to ascertain whether this substance is wholly animal or vegetable matter, or a mixture of both. When the smell emitted during the incineration is similar to that of burnt feathers, it is a certain indication of some substance either animal or analogous to animal matter; and a copious blue flame at the time of ignition almost always denotes a considerable proportion of vegetable matter. In cases when it is necessary that the experiment should be very quickly performed, the destruction of the decomposable substances may be assisted by the agency of nitrate of ammoniac, which at the time of ignition may be thrown gradually upon the heated mass in the quantity of twenty grains for every hundred of residual soil. It accelerates the dissipation of the animal and vegetable matter, which it causes to be converted into elastic fluids; and it is itself at the same time decomposed and lost.

7. The substances remaining after the destruction of the vegetable and animal matter are generally minute particles of earthy matter, containing usually alumina and silica, with combined oxyd of iron or of manganesum.

To separate these from each other, the solid matter should be boiled for two or three hours with sulphuric acid, diluted with four times its weight of water; the quantity of the acid should be regulated by the quantity of solid residuum to be acted on, allowing for every hundred grains two drachms or one hundred and twenty grains of acid.

The substance remaining after the action of the acid may be considered as siliceous; and it must be separated and its weight ascertained, after washing and drying in the usual manner.

The alumina and the oxyd of iron and manganesum, if any exist, are all dissolved by the sulphuric acid; they may be separated by succinate of ammonia, added to excess; which throws down the oxyd of iron, and by soap lye, which will dissolve the alumina, but not the oxyd of manganesum: the weights of the oxyds ascertained after they have heen heated to redness will denote their quantities.

Should any magnesia and lime have escaped solution in the muriatic acid, they will be found in the sulphuric acid; this, however, is rarely the case; but the process for detecting them, and ascertaining their quantities, is the same in both instances.

The method of analysis by sulphuric acid is sufficiently precise for all usual experiments; but if very great accuracy be an object, dry carbonate of potassa must be employed as the agent, and the residuum of the incineration (6) must be heated red for half an hour, with four times its weight of this substance, in a crucible of silver, or of well-baked porcelain. The mass obtained must be dissolved in muriatic acid, and the solution evaporated till it is nearly solid; distilled water must then be added, by which the oxyd of iron and all the earths, except silica, will be dissolved in combination as muriates. The silica, after the usual process of lixiviation, must be heated red; the other substances may be separated in the same manner as from the muriatic and sulphuric solutions.

This process is the one usually employed by chemical philosophers for the analysis of stones.

8. If any saline matter, or soluble vegetable or animal matter, is suspected in the soil, it will be found in the water of lixiviation used for separating the sand.

This water must be evaporated to dryness in a proper dish, at a heat below its boiling point.

If the solid matter obtained is of a brown colour and inflammable, it may be considered as partly vegetable extract. If its smell, when exposed to heat, be like that of burnt feathers, it contains animal or albuminous matter; if it be white, crystalline, and not destructible by heat, it may be considered as principally saline matter.

9. Should sulphate or phosphate of lime be suspected in the entire soil, the detection of them requires a particular process upon it. A given weight of it, for instance, four hundred grains, must be heated red for half an hour in a crucible, mixed with one-third of powdered charcoal. The mixture must be boiled for a quarter of an hour, in a half pint of water, and the fluid collected through the filtre, and exposed for some days to the atmosphere in an open vessel. If any notable quantity of sulphate of lime (gypsum) existed in the soil, a white precipitate will gradually form in the fluid, and the weight of it will indicate the proportion.

Phosphate of lime, if any exist, may be separated from the soil after the process of gypsum. Muriatic acid must be digested upon the soil, in quantity more than sufficient to saturate the soluble earths; the solution must be evaporated, and water poured upon the solid matter. This fluid will dissolve the compounds of earths with the muriatic acid, and leave the phosphate of lime untouched.

It would not fall within the limits assigned to this Lecture to detail any processes for the detection of substances which may be accidentally mixed with the matters of soils. Other earths and metallic oxyds are now and then found in them, but in quantities too minute to bear any relation to fertility or barrenness, and the search for them would make the analysis much more complicated without rendering it more useful.

10. When the examination of a soil is completed, the products should be numerically arranged, and their quantities added together, and if they nearly equal the ori-

ginal quantity of soil, the analysis may be considered as accurate. It must, however, be noticed, that when phosphate or sulphate of lime are discovered by the independent process just described (9), a correction must be made for the general process, by subtracting a sum equal to their weight from the quantity of carbonate of lime obtained by precipitation from the muriatic acid.

In arranging the products, the form should be in the order of the experiments by which they were procured.

Thus, I obtained from 400 grains of a good siliceous sandy soil from a hop-garden near Tunbridge, Kent,

		Grains.
Of water of absorption		19
Of loose stones and gravel principally siliceous		53
Of undecompounded vegetable fibres		14
Of fine siliceous sand		212
Of minutely divided matter separated by agitation and filtration, and consisting of		
Carbonate of lime	19	
Carbonate of magnesia	3	
Matter destructible by heat, principally vegetable	15	
Silica	21	
Alumina	13	
Oxyd of iron	5	
Soluble matter, principally common salt and vegetable extract	3	
Gypsum	2	
	—	81
Amount of all the products		379
Loss		21

The loss in this analysis is not more than usually occurs, and it depends upon the impossibility of collecting the whole quantities of the different precipitates; and upon the presence of more moisture than is accounted for in the water of absorption, and which is lost in the different processes.

When the experimenter is become acquainted with the use of the different instruments, the properties of the re-agents, and the relations between the external and chemical qualities of soils, he will seldom find it necessary to perform, in any one case, all the processes that have been described. When his soil, for instance, contains no notable proportion of calcareous matter the action of the muriatic acid (7) may be omitted. In examining peat soils he will principally have to attend to the operation by fire and air (8); and in the analysis of chalks and loams he will often be able to omit the experiment by sulphuric acid (9).

In the first trials that are made by persons unacquainted with chemistry they must not expect much precision of result. Many difficulties will be met with: but in overcoming them the most useful kind of practical knowledge will be obtained; and nothing is so instructive in experimental science as the detection of mistakes. The correct analyst ought to be well grounded in general chemical information; but perhaps there is no better mode of gaining it than that of attempting original investigations. In pursuing his experiments he will be continually obliged to learn the properties of the substances he is employing or acting upon; and his theoretical ideas will be more valuable in being connected with practical operations, and acquired for the purpose of discovery.

Plants being possessed of no locomotive powers, can grow only in places where they are supplied with food; and the soil is necessary to their existence, both as affording them nourishment, and enabling them to fix themselves in such a manner as to obey those mechanical laws by which their radicles are kept below the surface, and their leaves exposed to the free atmosphere. As the systems of roots, branches and leaves are very different in different vegetables, so they flourish most in different soils; the plants that have bulbous roots require a looser and a lighter soil than such as have fibrous roots; and the plants possessing only short fibrous radicles demand a firmer soil than such as have tap-roots, or extensive lateral roots.

A good turnip soil from Holkham, Norfolk, afforded me eight parts out of nine siliceous sand; and the finely divided matter consisted

Of carbonate of lime	63
— silica	15
— alumina	11
— oxyd of iron	3
— vegetable and saline matter	5
— moisture	3

I found the soil taken from a field at Sheffield-place, in Sussex, remarkable for producing flourishing oaks, to consist of six parts of sand and one part of clay and finely divided matter. And one hundred parts of the entire soil submitted to the analysis, produced

	Parts.
Silica	54
Alumina	28
Carbonate of lime	3
Oxyd of iron	5
Decomposing vegetable matter	4
Moisture and loss	3

An excellent wheat soil from the neighbourhood of West Drayton, Middlesex, gave three parts in five of siliceous sand; and the finely divided matter consisted of

Carbonate of lime	28
Silica	32
Alumina	29
Animal or vegetable matter and moisture	11

Of these soils the last was by far the most, and the first the least, coherent in texture. In all cases the constituent parts of the soil which give tenacity and coherence are the finely divided matters; and they possess the power of giving those qualities in the highest degree when they contain much alumina. A small quantity of finely divided matter is sufficient to fit a soil for the production of turnips and barley; and I have seen a tolerable crop of turnips on a soil containing eleven parts out of twelve sand. A much greater proportion of sand, however, always produces absolute sterility. The soil of Bagshot Heath, which is entirely devoid of vegetable covering, contains less than one-twentieth of finely divided matter. 400 parts of it, which had been heated red, afforded me 380 parts of coarse siliceous sand; nine parts of fine siliceous sand, and eleven parts of impalpable matter, which was a mixture of ferruginous clay with carbonate of lime. Vegetable or animal matters, when finely divided, not only give coherence, but likewise softness and penetrability; but neither they nor any other part of the soil must be in too great proportion; and a soil is unproductive if it consists entirely of impalpable matters.

Pure alumina or silica, pure carbonate of lime, or carbonate of magnesia, are incapable of supporting healthy vegetation.

No soil is fertile that contains as much as nineteen parts out of twenty of any of the constituents that have been mentioned.

It will be asked, are the pure earths in the soil merely active as mechanical or indirect chemical agents, or do they actually afford food to the plant? This is an important question; and not difficult of solution.

The earths consist, as I have before stated, of metals united to oxygen; and these metals have not been decomposed; there is consequently no reason to suppose that the earths are convertible into the elements of organised compounds, into carbon, hydrogen, and azote.

Plants have been made to grow in given quantities of earth. They consume very small portions only; and what is lost may be accounted for by the quantities found in their ashes; that is to say, it has not been converted into any new products.

The carbonic acid united to lime or magnesia, if any stronger acid happens to be formed in the soil during the fermentation of vegetable matter which will disengage it from the earths, may be decomposed: but the earths themselves cannot be supposed convertible into other substances, by any process taking place in the soil.

In all cases the ashes of plants contain some of the earths of the soil in which they grow; but these earths, as may be seen from the table of the ashes afforded by different plants given in the last Lecture, never equal more than one-fiftieth of the weight of the plant consumed.

If they be considered as necessary to the vegetable, it is as giving hardness and firmness to its organisation. Thus it has been mentioned that wheat, oats, and many of the hollow grasses, have an epidermis principally of siliceous earth; the use of which seems to be to strengthen them, and defend them from the attacks of insects and parasitical plants.

Many soils are popularly distinguished as *cold*; and the distinction, though at first view it may appear to be founded on prejudice, is really just.

Some soils are much more heated by the rays of the sun, all other circumstances being equal, than others; and soils brought to the same degree of heat cool in different times, *i. e.* some cool much faster than others.

This property has been very little attended to in a philosophical point of view; yet it is of the highest importance in agriculture. In general, soils that consist principally of a stiff white clay are difficultly heated; and being usually very moist, they retain their heat only for a short time. Chalks are similar in one respect, that they are difficultly heated; but being drier, they retain their heat longer, less being consumed in causing the evaporation of their moisture.

A black soil, containing much soft vegetable matter, is most heated by the sun and air; and the coloured soils, and the soils containing much carbonaceous matter, or ferruginous matter, exposed under equal circumstances to sun, acquire a much higher temperature than pale-coloured soils.

When soils are perfectly dry, those that most readily become heated by the solar rays likewise cool most rapidly; but I have ascertained by experiment, that the darkest coloured dry soil, (that which contains abundance of animal or vegetable matter; substances which most facilitate the diminution of temperature) when heated to the same degree, provided it be within the common limits of the effect of solar heat, will cool more slowly than a wet pale soil, entirely composed of earthy matter.

I found that a rich black mould, which contained nearly one-fourth of vegetable matter, had its temperature increased in an hour from 65° to 88° by exposure to sunshine; whilst a chalk soil was heated only to 69° under the same circumstances. But the mould removed into the shade, where the temperature was 62°, lost, in half an hour, 15°; whereas the chalk, under the same circumstances, had lost only 4°.

A brown fertile soil, and a cold barren clay, were each artificially heated to 88°, having been previously dried: they were then exposed in a temperature of 57°; in half an hour the dark soil was found to have lost 9° of heat; the clay had lost only 6°. An equal portion of the clay containing moisture, after being heated to 88°, was exposed in a temperature of 55°; in less than a quarter of an hour it was found to have gained the temperature of the room. The soils in all these experiments were placed in small tin plate trays, two inches square and half an inch in depth; and the temperature ascertained by a delicate thermometer.

Nothing can be more evident, than that the genial heat of the soil, particularly in Spring, must be of the highest importance to the rising plant. And when the leaves are fully developed, the ground is shaded; and any injurious influence, which in the summer might be expected from too great a heat, entirely prevented; so that the temperature of the surface, when bare and exposed to the rays of the sun, affords at least one indication of the degrees of its fertility; and the thermometer may be sometimes a useful instrument to the purchaser or improver of lands.

The moisture in the soil influences its temperature; and the manner in which it is distributed through, or combined with, the earthy materials, is of great importtance in relation to the nutriment of the plant. If water is too strongly attracted by the earths, it will not be absorbed by the roots of the plants: if it is in too great quantity, or too loosely united to them, it tends to injure or destroy the fibrous parts of the roots.

There are two states in which water seems to exist in the earths, and in animal and vegetable substances; in the first state it is united by chemical, in the other by cohesive, attraction.

If pure solution of ammonia or potassa be poured into a solution of alum, alumina falls down combined with water; and the powder dried by exposure to air will afford more than half its weight of water by distillation; in this instance the water is united by chemical attraction. The moisture which wood, or muscular fibre, or gum, that have been heated to 212°, affords by distillation at a red heat, is likewise water, the elements of which were united in the substance by chemical combination.

When pipe-clay, dried at the temperature of the atmosphere, is brought in contact with water, the fluid is rapidly absorbed; this is owing to cohesive attraction. Soils in general, vegetable, and animal substances, that have been dried at a heat below that of boiling water, increase in weight by exposure to air, owing to their absorbing water existing in the state of vapour in the air, in consequence of cohesive attraction.

The water *chemically combined* amongst the elements of soils, unless in the case of the decomposition of animal or vegetable substances, cannot be absorbed by the roots of plants; but that *adhering* to the parts of the soil is in constant use in vegetation. Indeed there are few mixtures of the earths found in soils that contain any chemically combined water; water is expelled from the earths by most substances that combine with them. Thus, if a com-a combination of lime and water be exposed to carbonic acid, the carbonic acid takes the place of water; and compounds of alumina and silica, or other compounds of the earths, do not chemically unite with water; and soils, as it has been stated, are formed either by earthy carbonates, or compounds of the pure earths and metallic oxyds.

When saline substances exist in soils, they may be united to water both chemically and mechanically; but they are always in too small a quantity to influence materially the relations of the soil to water.

The power of the soil to absorb water by cohesive attraction, depends in great measure upon the state of division of its parts; the more divided they are the greater is their absorbent power. The different constituent parts of soils likewise appear to act, even by cohesive attraction, with different degrees of energy. Thus vegetable substances seem to be more absorbent than animal substances; animal substances more so than compounds of alumina and silica; and compounds of alumina and silica more absorbent than carbonates of lime and magnesia; these differences may, however, possibly depend upon the differences in their state of division, and upon the surface exposed.

The power of soils to absorb water from air is much connected with fertility. When this power is great, the plant is supplied with moisture in dry seasons; and the effect of evaporation in the day is counteracted by the absorption of aqueous vapour from the atmosphere, by the interior parts of the soil during the day, and by both the exterior and interior during night.

The stiff clays approaching to pipe-clays in their nature, which take up the greatest quantity of water when it is poured upon them in a fluid form, are not the soils which absorb most moisture from the atmosphere in dry weather. They cake, and present only a small surface to the air; and the vegetation on them is generally burnt up almost as readily as on sands.

The soils that are most efficient in supplying the plant with water by atmospheric absorption are those in which there is a due mixture of sand, finely divided clay, and carbonate of lime, with some animal or vegetable matter; and which are so loose and light as to be freely permeable to the atmosphere. With respect to this quality, carbonate of lime and animal and vegetable matter are of great use in soils; they give absorbent power to the soil without giving it likewise tenacity; sand, which also destroys tenacity, on the contrary, gives little absorbent power.

I have compared the absorbent powers of many soils with respect to atmospheric moisture, and I have always found it greatest in the most fertile soils; so that it affords one method of judging of the productiveness of land.

1000 parts of a celebrated soil from Ormiston, in East Lothian, which contained more than half its weight of finely divided matter, of which eleven parts were carbonate of lime, and nine parts vegetable matter, when dried at 212°, gained in an hour by exposure to air saturated with moisture, at temperature 62°, eighteen grains.

1000 parts of a very fertile soil from the banks of the river Parret, in Somersetshire, under the same circumstances, gained sixteen grains.

1000 parts of a soil from Mersea, in Essex, worth forty-five shillings an acre, gained thirteen grains.

1000 grains of a fine sand from Essex, worth twenty-eight shillings an acre, gained eleven grains.

1000 of a coarse sand, worth fifteen shillings an acre, gained only eight grains.

1000 of the soil of Bagshot Heath gained only three grains.

Water, and the decomposing animal and vegetable matter existing in the soil, constitute the true nourishment of plants; and as the earthy parts of the soil are useful in retaining water, so as to supply it in the proper proportions to the roots of the vegetables, so they are likewise efficacious in producing the proper distribution of the animal or vegetable matter; when equally mixed with it they prevent it from decomposing too rapidly; and by their means the soluble parts are supplied in proper proportions.

Besides this agency, which may be considered as mechanical, there is another agency between soils and organizable matters, which may be regarded as chemical in its nature. The earths, and even the earthy carbonates, have a certain degree of chemical attraction for many of the principles of vegetable and animal substances. This is easily exemplified in the instance of alumina and oil; if an acid solution of alumina be mixed with a solution of soap, which consists of oily matter and potassa; the oil and the alumina will unite and form a white powder, which will sink to the bottom of the fluid.

TO BE CONCLUDED IN OUR NEXT.

New

New Method of preserving Potatoes.

By the Rev. Anthony Dow, D.D.

From the Transactions of the Caledonian Horticultural Society.

FOR some years I have bestowed considerable attention on the mode of preserving that most useful and valuable vegetable, the potatoe. I have tried many various ways of keeping it; but have found none so good as the following, which I have employed these two last years with the best success.

That part of my potatoes which I mean to keep longest, that is for Spring and Summer use, before the succeeding crop be ready, I put into small pits, holding about two bolls each, heaped up and covered in the usual mode, with straw and earth. In April or May, according to the heat of the season, these potatoes are turned over into other pits; after carefully rubbing off or picking out the shoots or buds, and laying aside every one that has any blemish or tendency to spoil. The evening before, a new pit is dug, or an old one cleaned out, in some dry spot; and, if possible, under the shade of some tree, wall, or stack of hay, &c. This is filled nearly full of water; which by next morning is all drunk in, and the earth well cooled all round in the pit. The potatoes, carefully picked of all their shoots, are put into the pit thus prepared; and every quantity, of a firlot or half boll, is watered as it is put in, till the potatoes are level with the surface of the ground; they are then covered with live turf, the green side next the potatoes, and a hearty watering given; when the whole is covered to the depth of two feet, with earth, watered, and well beaten together with the spade. This process is repeated every time the potatoes are turned over, which is about once in three weeks, less or more, according to the weather. When it is very hot, and the pits or heaps not in the shade, it is proper sometimes to cover the pit or heap with a mat, supported on a few sticks, so as to allow a free current of air between the mat and the heap.

In this way I have been enabled to preserve potatoes quite plump, and entire in taste, to the end of September, or till the succeeding crop be sufficiently ripe to be used without loss; and loss must always be sustained in the quantity, when potatoes are largely used before they be nearly ripe. Nay, in this way, potatoes may be recovered in plumpness and taste when they have suffered by injudicious exposure to air or heat, or by necessary carriage. In July last I had occasion to send some potatoes, for the use of my family, at sea-bathing quarters, a distance of sixteen or seventeen miles. They were taken out of the pit, and put into a sack; but it was three or four days before they were sent off; and when they came to be used they were found to have lost much of their fine taste, and somewhat of their mealiness. I immediately made a small pit in the back ground belonging to the house I possessed; into which, when well watered, the potatoes were put, watered and covered, as already described. In five days the pit was opened, and the potatoes had recovered both their dryness and taste.

Observations on the Colouring Matter of Coffee, and on the Bitter Principle that has been supposed to exist in it.

By M. BRUGNATELLI.

From ANNALES DE CHIMIE.

Green Colour obtained with Coffee and Albumen.

1st. A FEW ounces of coffee, well bruised, were put into a glass recipient with the white of egg; at the end of twelve hours the albumen had acquired a beautiful emerald colour. This phenomenon has already been announced by M. Seguin.

2d. This green albumen dyed paper of the same colour; it coagulated with heat without altering, and became discoloured by chlorine in the same manner as most other vegetable colours. Treated with alcohol the albumen coagulated, but preserved its colour, and the alcohol itself took a green tint.

Hydro-chloric acid coagulated the green albumen, and the colour changed to red. The sulphuric and nitric acids weakened, produced the same effect. Citric acid decoloured the green albumen.

3d. Roasted coffee gave no colour to albumen.

4th. The coffee which had been used to colour the albumen had acquired a dull green: that portion of it which had not taken this tint was capable of colouring fresh albumen.

5th. A decoction of coffee, of a faint greenish yellow, mixed with albumen, gave in a few hours a fine delicate green tint. A few grains of soda added to the decoction produced in a few hours a clear green tint.

6th. Coffee that had been boiled in water, when put in contact with albumen, gave it a fine green in a few hours.

7th, Half an ounce of alcohol, that had macerated for eight days upon half an ounce of coffee, did not appear to dissolve any substance. It retained its odour almost without alteration, and remained insipid and transparent, but with a slight yellow colour. Mixed with albumen it coagulated, and remained white, but at the end of a few hours the alcohol and albumen acquired a fine emerald green colour. The alcohol that had macerated on the coffee took a greenish colour with soda, became yellow with ammoniac, and gave a green colour with trito-sulphate of iron. Paper wetted with this alcohol is perfectly colourless; it becomes coloured by ammoniac.

8th. Unroasted coffee, put in contact with white of egg, coagulates with heat, and gives a green colour in a few hours to the points that it touches.

9th. Coffee, put into the red serum of human blood, precipitated in a few hours the colouring matter of a very bright red, and the floating serum took a fine green colour.

10th. Coffee communicates no colour at all to the yolk of egg nor to milk; but the latter, when kept a long time in contact with coffee, and mixed afterwards with albumen, gives it a green colour.

11th. The coffee that has given a clear green to albumen, will manifest in a few days a *zone* of clear yellow. The grains of coffee, when completely separated from the albumen, washed and dried, give to fresh albumen a fine green.

12th. Coffee, when put into a mucilage of transparent and inodorous gum arabic, gives to the gum the smell of coffee and a brownish colour; mixed with the white of egg, it (the mucilage) acquires in a few hours a greenish tint.

An emerald Green Colour extracted from Coffee by Means of Soda; and the singular Phenomenon observed with the Solution.

Coffee grains, well bruised and put into a sufficient quantity of pure water, containing a few grains of soda, give in twenty-four hours a greenish tint, which becomes a very deep emerald green.

An ounce of this green tincture was inclosed in a glass vessel, well stopped, and in which there were only a few bubbles of air. In six days, the temperature being at +15° of Reaumur, the tincture lost its green colour, and became of a deep yellow. Some drops of this liquor, poured into a glass, resumed the clear green colour in a few seconds. The green tincture, evaporated in the sun to dryness, moistened and spread upon paper with gum-water, dyes it green.

A fine Green extracted from Coffee by the Alkaline Alcohol of Soda.

An ounce of bruised coffee was put into two ounces of alcohol, to which were added two drachms of solution of soda. The liquor was heated in a glass vessel; in two hours it was green, but the colour became more intense. After two days of maceration the colour formed no precipitate in the solution. The alcoholic liquor evaporated in the sun, with the contact of the air left a colouring matter of an emerald green, much more beautiful and brilliant than that obtained with alkaline water, and more easy to be employed in painting.

Action of Ammoniac and other Liquids upon Coffee.

Half an ounce of ammoniac poured upon half an ounce of bruised coffee, immediately acquired a fine yellow colour,

lour, which continued to increase until at the end of twenty-four hours it became very deep. The coffee was equally yellow; and on being put in contact with fresh ammoniac coloured it in the same manner in a few hours. When separated again from the ammoniac, and infused in distilled water, it acquired in a few hours a fine green colour, and gave the same tint to water. The same phenomenon was exhibited with the ammoniac. The ammoniac, that had received a yellow tint from the coffee, was decoloured by means of acids. When placed in the sun until all the ammoniac had volatilised, the liquor lost its fine yellow colour, became inodorous, and of a fine green. The coffee, even that was separated from the ammoniac, and exposed to the air, passed from yellow to green.

Absence of the Bitter Principle in unroasted Coffee.

The brilliant yellow substance extracted by the ammoniac from coffee, and separated by evaporation from the liquid, is not bitter, and this matter is very different from the bitter principle obtained by M. Seguin, with alcohol and unroasted coffee, by exposing it to a temperature of 5° Reaumur, to separate the oil from it.

The author having evaporated in the sun, to the consistence of honey, some alcohol kept for a long time upon unroasted coffee, and which was of a yellowish colour, the oil deposited on the sides of the recipient, and the residuum was unctuous to the touch. It was a little bitter, but, in his opinion, this taste is to be attributed to a mixture of the colouring matter with the oil and alcohol; for if they are separated by heat the bitter taste is lost.

Unroasted coffee gives no sign of bitter by mastication, and it is not extracted by infusion or aqueous decoctions.

coctions. The particular taste of coffee is to be attributed not to the bitter principle, but to the peculiar smell and flavour of the aromatic oil contained in it. The existence of the aromatic oil discovered by M. Seguin is also manifested by its property, which that author observed, of producing motion in pure water, which is equally the case with other seeds that contain aromatic oils.

Report of M. de LASTEYRIE *on the Specimens of Pitch and Tar manufactured in France, after the Process of M.* BADEIGTS LABORDE.

From the ANNALES DES ARTS, &c.

THE soil of France, rich in the variety and excellence of its products, is abundantly provided with different kinds of resinous trees, from which pitch and tar are produced. These substances, which are of the highest consequence to our marine, would be sufficiently plentiful for our own use, and even furnish a lucrative article for exportation, if they possessed the qualities which distinguish those we receive from the North of Europe. The pitch and tar that is manufactured in *les Landes* of Bordeaux or Provence being very inferior to these, and not fit to be used for the same purposes, are consequently of less value. Thus the first are sold for thirty francs the metrical quintal, and the latter for only seventeen francs. Does this difference of quality proceed from the nature of the soil, the climate, and the trees, or only from the mode of extracting the resin? It has always been thought, and it is still generally believed, that the superior quality of the tar of the North is owing to the climate, and the nature of the trees that grow in those regions. But it is possible that this opinion may be a prejudice, which, like many others, has been transmitted to us from remote ages, and can only be destroyed by enlightened observation and experience. M. Laborde, a seaman by profession, and an inhabitant of the department *des Landes*, which produces a great quantity of tar, has not only made particular observations on the manner in which it is prepared, but he has compared the mode of preparation with those in use in the North. His researches, and the experiments he has been induced to make, have convinced him that the resinous trees of France are capable of affording the means of preparing pitch and tar equally good as those which are brought at a great expense from the North of Europe, and that the difference of the product is owing solely to the defective method of preparing them among ourselves. He has observed, that the pitch of Sweden is unctuous and tenaceous, while our own is dry and brittle, and consequently less useful. That the tar which is brought from the same country is fluid, uniform, and homogeneous in all its parts; that of France is too thick; it has the consistence of a lumpy paste, which shews that the fusion has not been complete, and that it has lost during the combustion the volatile parts which should be united with it. It contains a great quantity of water, sand, and other heterogeneous matters, which injure its quality, and considerably diminish its value.

The granulated part of our own tar destroys its homogeneousness, and renders it unfit to resist blows and friction; it also makes it less firm and tenaceous upon wood, for it is soon reduced to a powder, falls off, and leaves the wood bare. When applied to cordage it is subject to greater inconveniences, for it not only does not penetrate it sufficiently, but the filaments which compose cables being coated with a dry and inflexible substance, lose their elasticity, and break or tear very speedily.

M. Laborde has succeeded in giving to our own pitch the degree of unctuousness and durability which has hitherto been the exclusive property of the Northern product, and he has rendered a great service to our marine, since the pitch produced in France is otherwise of no use, at least without it is mixed with suet or other fat substances, which greatly augments its price.

Having satisfied himself that our own tar is formed of the same constituent parts as the Northern, and that its inferior quality proceeds solely from the bad construction of the stoves, and imperfect manipulation employed in manufacturing it, he has invented new apparatus, and new processes for that purpose. He has even discovered a method of rectifying the ordinary tar of commerce, and of making it equal in quality to that of Sweden: a discovery which is the more valuable, as from this time it secures to France a product of the best quality. It is only necessary to this effect to form an establishment for rectifying the common tar produced in *les Landes.* The method of rectification invented by M. Laborde is as simple as it is ingenious, and is undoubtedly beneficial, since, without sensibly augmenting the intrinsic price of tar, it keeps it at a lower rate than the same substance that comes from the North. Indeed M. Laborde's rectified tar, according to his calculation, may be sold in commerce at 22 francs, while the Swedish tar is at least 30 francs. He describes his process in a few words, as follows: "Heat the substance sufficiently to evaporate all the water, give it the proper degree of fluidity, by restoring to it the essential oil that is wanting, and be careful to extract from it all heterogeneous particles. This is the whole of my operation."

The products obtained by the inventor of this process, submitted to the examination of several commissions nominated by the Maritime Prefects of Rochefort, or by the *Societé des Sciences* of the same town, have been unanimously pronounced good. Messrs. D'Arcet, Bose, and myself, have examined specimens that have been returned with the memoir which gives an account of them. These specimens are three pieces of pitch; one piece came from Sweden, another was produced from *les Landes,* of Bordeaux, and the third from the same country, but prepared according to M. Laborde's method. This piece presented to the touch and to the eye the same properties as the Swedish. The ordinary piece from *les Landes* is dry and friable. We also received three specimens of tar: the first manufactured in *les Landes,* and the second in Sweden, possessing the characters before described; the third piece came also from Landes, but rectified according to the process of M. Laborde; it has the same qualities as the second, and appears to afford the same advantages in the uses for which it is employed. In order to give greater certainty to our experiments, we procured some tar of commerce, of an inferior quality, we treated it according to the process described, and we obtained a substance, having all the appearance of the best Northern tar.

The incomplete experiments to which we submitted it did not admit of our ascertaining exactly the parity or disparity between them. It would be desirable for the inventor of the process to send a certain quantity of pitch and tar, in order that a comparative analysis might be made with them, and that they might be submitted to tests which can alone establish the quality positively.

M. Laborde, who has acted with as much zeal as perseverance in the experiments he has made for the improvement of French tar, was desirous that Government should immediately put the country in possession of the useful discoveries of which he is the author, and that they should send certain persons to different parts of *les Landes* for the purpose of teaching the tar-makers in that country how to construct good stoves, and to use his method. But in consequence of our observations on the difficulties that would attend the realization of this project, he determined to form, at his own expense, an establishment for refining the tar of commerce. The following is extracted from M. Laborde's Memoir on the Pitch and Tar of France.

1. *On the Extraction of Tar from the Pine Tree, as practised in les Landes de Bordeaux.*

In the first place, they begin to fell the trees from the 15th of September to the 1st of November. As soon as they are on the ground about twelve feet of the trunk is cut off. This block of twelve feet, which is the only part from which it is proper to extract the tar, remains on the ground all the ensuing Winter; in the Spring they are again cut in two, and split into eight pieces each, which are afterwards set upright, and ranged like arms, in bundles or piles. The air surrounding them in all directions during the heat of summer, make the wood properly dry. In September, the period of distillation, these billets are again cut in two longways, and split till they are only about an inch in thickness. They finish drying during the time that is required for the cutting and conveying them to the kiln. It is to be observed, that the portion of the trunk that remains in the ground attached to the roots, and the roots themselves, are parts of the tree that produce the finest and purest tar, and in the greatest quantity; but it is necessary that these stumps should remain in the ground for three or four years, in order that all the moisture may dry away, and destroy the whole of the sap. It is very essential to know the period when the wood is suitably dry, for on that depends in some degree the success of the distillation. We have described the time necessary to make it so, but we think that the variations of the atmosphere may hasten or retard it, and that it is impossible to describe certain indications, which can only be known by long experience and observation.

The tar kiln is always fixed at a distance from inhabited buildings and the forest, that no accident by fire may be risked. It consists of only three parts; the floor, the cave or recipient, and the gutter. The concave floor, from ten to fifteen metres in circumference, is fixed upon a rising ground, of about two metres, and paved in the middle to about two-thirds of its extent; the space beyond is furnished with tempered clay, forming a circle of about two-thirds of a metre wide round the paved part. In the centre is a round aperture, which communicates with the gutter that is made to receive and conduct the tar into the hollow floor.

This consists of a parallelogram ditch, a metre in depth, and capacious according to the size of the kiln; its interior is furnished with squared planks, roughly joined together, and covered over in the manner of a shed, with planks that are charged with earth, and placed longways, according to the inclination of the plan of the floor, a part of which this covering supports.

The gutter, which begins at the pavement, is constructed of bricks; it abuts to a piece of hollow wood, placed vertically, and adjusted to another gutter, which is placed in an oblique direction, forming an obtuse angle with the first. This last gutter passes behind the planks from the bottom of the recipient, where it is firmly fixed, and enters it to about fifteen centimetres: its aperture is six or seven centimetres in diameter. The end of a pole is inserted into this aperture, and serves to stop it; the pole is supported at the other end by a cord in the front of the recipient, by this means the gutter can be shut and opened at pleasure. This is the principal and very defective apparatus that is used for distilling tar. The utensils consist of besoms, hatchets, pickaxes, hoes, iron rakes, buckets, casks, staved barrels for water, and empty barrels to hold the tar, &c. When they proceed to the distillation, all the wood that is intended for that purpose is carried to the foot of the kiln, which is charged in the following manner. First, by fixing a long pole of pine wood vertically in the kiln, at the hole which is to carry the tar into the gutter, then the billets are ranged in an upright position along the sides of the oven, following its circumference; a second course is laid down, in order to support the first, and so on. The pile being complete, it is left a few days to settle before it is capped. This precaution is indispensable, for if omitted, the pile, by sinking after the kiln is capped, would leave crevices, by which the air entering with force would occasion a violent combustion, and in an instant consume all the tar. When the pile is sufficiently settled they proceed to the capping, which is done by spreading chips of pine wood over the pile. This operation being finished, dried leaves or straw are thrown over the whole, which is then carefully covered over with tiles, or clods of earth, of bog turf. Small intervals, not filled with clods, are left, by which it may be lighted in case the fire should require re-animating. It is then left to consolidate for twenty-four hours before the fire is applied to it.

As soon as the fire is lighted the distillation commences, and at this moment, which is the most critical in the whole operation, as it acts according to the direction the fire takes, eight or ten men surround the kiln, armed with shovels, pickaxes, poles, &c. in order to be ready to cure immediately any accidents that may take place. When the distillation is in train, and the fire has taken a regular course, these men are dismissed; one man and an assistant being sufficient to manage the operation. It requires considerable experience to manage it well, for the fire takes constant attention; if it is too brisk, it dissipates and even burns a part of the material; a strong fire does not cause exactly the same inconveniences, but it volatilises it, and renders the tar too dry; a concentrated and feeble heat does not extract all the resinous parts contained in the wood, and leaves in the produce all the aqueous part that escapes. In the course of the operation, the first or second day especially, it happens, that, according to the action of the fire, in order to regulate it properly, it is necessary to light successively the different air holes that were left unfilled with turf when it was capped, so that almost always, towards the termination of the work, the kiln is crowned with a circle of fire. At the end of fifty or sixty hours the attending workman opens the gutter, to see where the tar is. If it runs fat and red it is not sufficiently done, and he immediately recloses the aperture. In ten or twelve hours more he looks again, and it has usually by that time acquired its proper qualities: he then suffers it to run until it is exhausted, or till the tar shews indications that oblige him to reject it. It is commonly allowed to run three or four times during the distillation, which lasts four or five days without interruption, at a distance of nearly twenty hours between each time. There is also another attention which the workman must not neglect, which is, to knock lightly with a piece of wood on the capping as the wood consumes and the charge of the kiln sinks; if this be not done the empty space would make the fire too active.

At the first view this manner of proceeding would appear injudicious, and that it would be better, on the contrary, to take a very different course, more like that of other distillations; but it acts less for the simple operation of distilling than to obtain a triple result; the extraction of the matter; a sufficient degree of heat, and the volatilisation of the aqueous portion contained in the wood, extracted with the resinous liquor; it cannot, therefore, be otherwise effected. To obtain this triple result, a certain quantity of the matter is suffered to collect on the floor of the kiln, exposed to the whole action of the fire, and which remains there until it is judged that it has acquired the perfection that is desired. The conduit is not opened for the first time until sixty or seventy hours after the fire is lighted, because the kiln which, when not in use, is exposed without shelter to the air, necessarily contains much moisure; that it takes considerable time and heat to absorb it entirely; and the whole of the pile, as soon as it begins to heat, throws out the greatest part of its aqueous portion, which cannot therefore be entirely volatilised in less time. The periods of opening the conduit may be nearer together, because the moisture is almost entirely destroyed at the time of the first opening of the canal, as the wood furnishes very little more, and the fire acquires every hour a greater degree of intensity.

If the operation above described has been well conducted, if the fire has been properly regulated, if no deviation has been made from the directions given, and especially if no rain has fallen, we may affirm that the tar produced will be of a satisfactory quality. It is, however, to be observed, that the tar which runs out at the first opening of the canal is the fattest or richest, has received less heat, and consequently is most inferior in quality; the second and part of the third is better; the fourth is meagre, black, burnt, and too liquid. If the reservoir were large enough to contain the whole of the produce of one oven full, there is no doubt but that these three parts mixed would make excellent tar, but it hardly contains one-fourth, so that it is necessary to empty it each time the tar is suffered to run out.

The tar, thus prepared, is known by its hazle nut and golden colour, it is velvety to the touch, and liquid, so that when it is submitted to the proof, a rod of wood, about the thickness of a gun-barrel, and about a metre long, is put in at the bung-hole of a full barrel, it is suffered to sink of itself, its own weight being sufficient to carry it to the bottom of the cask, in which it slowly descends, as it meets with very slight resistance. When it is drawn out it is more than double its bulk, from the tar that has adhered to it, but in two or three minutes it will all fall off again. This tar is usually put into hogsheads of 300 kilogrammes, or into smaller casks of 100 kilogrammes.

A common kiln generally affords about fifteen hogsheads of tar, of 300 kilogrammes each, and from 220 to 240 hectolitres of charcoal. It requires to fill it forty-five loads of wood, of the weight of 500 kilogrammes each.

TO BE CONCLUDED IN OUR NEXT.

List of Patents for Inventions, &c.

(Continued from Page 128.)

John Hawkins Barlow, of Leicester-place, Leicester-square, Middlesex, Goldsmith and Jeweller: for certain improvements on tea-urns, tea-pots, tea-boards, or tea-trays. Dated June 27, 1816.

John Barlow, of Sheffield, Yorkshire, Founder; for a new cooking apparatus. Dated July 2, 1816.

John Towers, of Little Warner-street, Cold Bath-fields, Middlesex, Chemist; for a tincture for the cure and relief of coughs, asthmas, and diseases, which he intends to denominate "Towers's New London Cough Tincture." Dated July 11, 1816.

ERRATA.

Fig. 3, Plate II. vol. XXIX. line D F E wants an N below A.
Page 17, line 27, *for* obtuse *read* acute.
Page 18, line 11, *for* curve *read* curves.
Page 19, line 24, *for* R T S V *read* R I S.

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AGRICULTURE.

No. CLXXII. SECOND SERIES. Sept. 1816.

Specification of the Patent granted to WILLIAM PLENTY, *of Newbury, Berks, Iron Founder; for a Plough, on a new and improved Construction**. Dated Dec. 22, 1815.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said William Plenty do hereby declare that my said invention is described in the drawing hereunto annexed, and the description hereunder written. In witness whereof I the said William Plenty have hereunder set my hand and seal the twenty-first day of February in the said fifty-sixth year of the reign of his Majesty King George the Third, and in the year of our Lord one thousand eight hundred and sixteen.

The following is a specification of my Patent for a Plough.

The beam in the first place is curved, which gives the ploughman an opportunity of seeing his furrow, and enables him to work in a direct line with more facility than in any plough now in use. To the beam is fixed, by means of screw bolts and nuts, a body of cast iron, which projects over the land side, being fitted to the curved beam, and is cast so as to form at top two plates, one of which goes underneath the beam through which the screw bolts pass to fix it to the beam, and the other on the furrow side or face of the beam. The bottom part of the cast iron body, where the share is fitted on, is cast with a hollow; the convex side fills up the interstice between the body of the mould plate, the concave or opening being on the land side of the body, and which, when the shoe is screwed on, form a box, within which are the nuts and screws which fasten the mould plate and share to the body, protected from all friction in the action of ploughing. The mould plate is of cast iron, curved, and fastened to the body by means of screw bolts and nuts, which come within the box above described. The share is also fixed to the body by means of a curved screw bolt and nut, protected within the same box. The share has also a wing, in an horizontal position, which serves as a cutter in ploughing. In the space between the body and mould plate is a friction wheel, of cast iron, one end of the axle of which is fixed in a grooved wrought iron arm; which grooved arm fits in another groove on the land side of the body, and the other end of the axle in a groove fixed to the inside of the mould plate; and the axle by thus working by grooves, the wheel may be elevated or depressed according to the proposed depth of the furrow. The fore carriage consists of a carriage or gear plate, of cast iron; in the front of which one wheel runs on a wrought iron axletree, and the other wheel on another wrought iron axletree at the back part of the plate, both axletrees being attached to the plate by screw

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* The patent was granted for a plough or agricultural implement, made on a new or improved principle, answering a two-fold purpose, so that land or ground may be thereby both pared and plouged.

bolt

bolts and nuts, so that one wheel is before the other; the front or furrow side wheel going in the furrow, and the rear wheel going on the land. From the axletree of each wheel goes a screw bolt, with an eye to hold the axletree through the collars round the beam, by which the fore carriage is fastened to the beam; and by means of a winch working on the screw of these eye bolts, the wheels, either or both of them, may be elevated or depressed at pleasure, or according to the depth of the furrow. From the rear axletree a dol or draft chain goes to the body, and fixes, by means of a hook in a hole, in the body, by which the draft is from the body itself. A small scraper is fixed over the friction wheel, from the handle, which keeps it clean. The plough handles are as usual; one of which fixes in a groove in the cast iron body, and the other is either bolted or morticed into the beam.

For the more minute particulars the details in the annexed drawing may be referred to.

Fig. 1 (Plate VII.) is the perspective view of the plough as put together. *k* is the beam. *a* the cast iron body. *c* the mould plate. *f* the share. *b* the friction wheel, in the space between the body and mould plate with the scraper *n*. *m* the coulter. *d* the ground rest.

The Fore Carriage.

g the carriage or gear plate. *p* the fore and rear axletrees. *r* the winches, which, working on the eye screw bolts, elevate or depress the wheels. *h* the collars which go round the beam, and through which the eye screw bolts pass, and by which the fore carriage is fixed to the beam. *u*, rods running parallel with the beam, and which keep the two collars at their proper distance, the ends being fastened to the collars. *x* the nuts which work on the eye screw bolts, and raise or depress the wheels. *o* the draft or dol chain, fixed on the hind axle and to the body by a hook, through a hole in the body.

The above is a general outline of the plough, as seen in the perspective, Fig. 1. The details of the several parts are as follows.

k, Fig. 7, the beam, made of wood curves, over the land side, and by this means obviates an objectionable angle; the curve comes into the line of draught about one-fourth part (eighteen inches) from the end of the beam. The front end of the beam is covered with plate iron, to prevent its wearing in the collars.

a, Fig. 8, the cast iron body. Fig. 8 *a* is the furrow side, as partly seen in the perspective drawing of the plough. Fig. 8 *b* is the other side, or land side of the body; it is made to project over the land side, to admit and fit the curved beam. The upper part forms two plates at right angles, which fit the bottom and furrow side of the beam, to which it is fastened by wrought iron screw bolts and nuts; the bolt holes being marked on the plan of the beam, and the plate on which the beam rests being seen in perspective in the drawing Fig. 8 *b*. At the bottom of this drawing (Fig. 8 *a*,) the convex part of the box is shewn by this mark ✱, into which the screw bolts and nuts go that fasten the mould plate and the share. This convex part fills up the interstice between the body and mould plate on the other drawing Fig. 8 *b*. The concave part is shewn with the bolts, as it appears before the shoe is fixed on. There is a partition in the box, against which the nut of the curved screw bolt fixes, to fasten the share, as shewn in the plate representing the concavity of the box Fig. 8 *b*. *s s s*, at the top of the drawing, [Fig. 8 *a*,] are grooves, the two front ones for the coulter, the rear one for one of the plough handles, the other being fixed in the beam. W, Fig. 8 *b*, the groove in which the arm of

IX. S.S.

M^{r} Plen

Fig. 1.

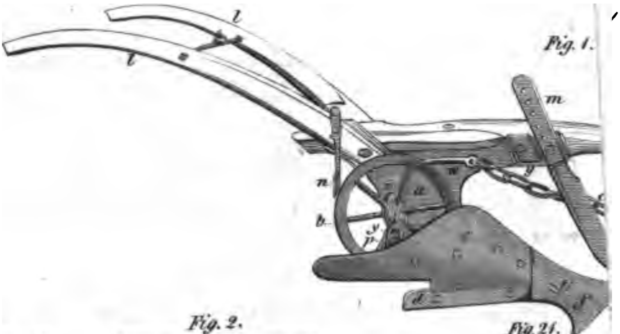


Fig. 2.

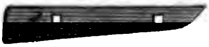


Fig. 21.

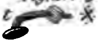


Fig. 16.

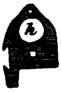


Fig. 19.

Fig. 17.

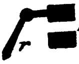


Fig. 18.

Fig. 3-

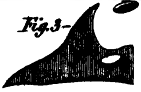


Fig. 3 19.

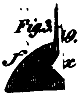


Fig. 15.

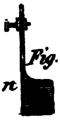
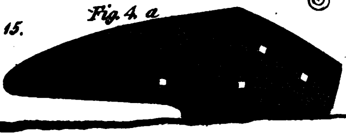


Fig. 4. a



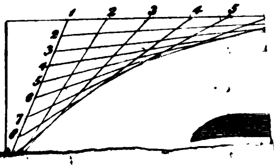
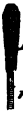


Fig. 15.



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of the friction wheel, Fig. 11, is worked, and by which the arm of the axle is elevated or depressed. *c*, Fig. 4, the mould plate, the curve of which is obtained by means of the intersection of lines, as described at Fig. 5. This plate fixes to the body by means of screw bolts and nuts, the nuts being in the hollow or box part of the body as above described. Fig. 4 *a* is the convex or furrow side of the mould plate, as seen in the perspective drawing of the plough, Fig. 1 *c*; and Fig. 4 *b* is the concave or inside of the mould plate, to which is fixed, by screws and nuts, the groove *y*, into which is screwed one end of the axle of the friction wheel, the other working by a groove in the body, as above described.

Fig. 3 is the share; *a b c* three views of it; *a* the bottom part, which lies flat on the ground, *b* the upper part, *c* a perspective. It screws on the body by means of a curved screw bolt, Fig. 21, introduced at the hole *t*, the nut of which and screw end are in the hollow or box part of the body above described. In the perspective drawing of the plough, Fig. 1, the wing of the share marked thus ✱ appears to stand perpendicularly, but it is horizontal, and serves as a cutter in ploughing. *d* the ground rest, Fig. 2, with holes to admit bolts and nuts to fix it to the mould plate, Fig. 4. This can be replaced when worn out see bottom of perspective plough *d*. *e*, Fig. 9, the shoe or bed: this does not appear at all in the perspective drawing of the plough, being on the further side of the point of view. It is fixed to the body, Fig. 8, by a bolt, and covers the concave part of the body, in which are the nuts and screw end of the bolts that fasten the share and mould plate so as to form a box, in which they are secure from all friction. This must be removed to get at those nuts, in order to take off the mould plate or share: this may also be replaced when worn out. *b*, Fig. 11, the friction wheel, of cast iron, which works in the space between the mould plate and the body: one end of the axle is a grooved arm *k*, which, by means of that groove, may be elevated or depressed by means of a screw and nut, by which that arm is fixed to the body at W, [Fig. 8 *b*]. The other end of the axle being fixed in the groove *y*, within side the mould plate, by means of two nuts, between which the axle end is fastened in the groove, and may also be raised higher or lower, and the mould plate may be removed further, or brought nearer the body, so as to widen or narrow the furrow, and as is also seen in the perspective drawing of the plough *y*. Fig. 13, the edge view of the friction wheel, with the grooved arm *k*, and the nuts by which the other end of the arm is fixed to the groove *y*, within side the mould plate. *g* the axle, or gear bed. Fig. 10 has holes to fix, by bolts and nuts, the axle of the two wheels on the fore carriage and the drail with draft' hooks Fig. 14. The front wheel when in action runs in the furrow already cut, and the hinder wheel upon the land which, by means of the screws *i*, Fig. 18, regulates the depth in paring or ploughing. The front axle, Fig. 12, is carved for the screw bolts *i* to work on when the plough is turning. *h* the collars, Fig. 16, through which the beam, Fig. 7, passes. These are kept at a distance from each other by two wrought iron bars or rods *u*; they also have holes for the screw bolts *i* to pass through. *i* two screw bolts, Fig. 18, made of wrought iron, which pass through the collars, Fig. 16, and, by means of the eye (see Fig. 18) at bottom, receive the axle of each wheel, and are raised and lowered at pleasure by means of the winch, with falling handles, Fig. 17. *l* the handles, Fig. 20, made of wood. *m* the coulter, Fig. 6, is fixed in the groove *s*, on the furrow side of the body, Fig. 8. *n* the scraper, Fig. 15, is fixed on the furrow side of the handle, over the friction wheel, Fig. 11, to scrape off the earth that collects upon it. *o* the dol or draft chain, fastens and connects the fore carriage and the body of the plough by means of the ring and hook *w*. *p* the axles or arms of the front wheels. *q* the wilding or drail, Fig. 14. *r* the winches or nuts, with falling handles, Fig. 17. *s s s* grooves to admit the coulter, and one of the plough handles. *t* a nut and screw to fasten the share to the body, Fig. 21. *u* a rod, to prevent the shifting of the collars *h*. *v* a ferrul, to prevent the collars from passing higher up the beam. *w* the ring and hook of the dol or draft chain. *x* the nuts, Fig. 19, on which the collars with falling handles, Fig. 17, affix.

Specification of the Patent granted to DUDLEY ADAMS, *of Fleet-street, in the City of London, Optician and Mathematical Instrument-maker; for certain Improvements in the Construction of Paper and Vellum Tubes for Telescopes, and in the Optical Parts of Telescopes.*

Dated March 7, 1815.

With an Engraving.

TO all to whom these presents shall come, &c. NOW KNOW YE, that I the said Dudley Adams, in pursuance of, and compliance with, such proviso, in the said recited letters patent contained, do by this instrument under my hand and seal, particularly describe and ascertain the nature of my said invention, and in what manner the same is to be performed, by the explanations, descriptions, and drawings, hereinafter contained and referred to; that is to say: The first part of my invention is an improved method of making tubes, composed of paper and vellum, of a form perfectly cylindrical, and of sufficient strength to receive and hold metal screws, and other parts necessary to the construction of telescopes of various kinds and sizes in common use, and of mounting and putting the tubes together in such a manner as that the varnish and ornamental figures or devices of painting or gilding on their outsides may not be injured by drawing out or closing the tubes. The method of making the tube is as follows: I compose the tubes of paper and vellum, in the following manner. First; a coat of post or writing paper, which I call the water coat. Secondly; another coat of post or writing paper. Thirdly; a coat of blue, brown, or bag cap. Fourthly; another coat of post. And, lastly, the vellum thus forming a substance, consisting of four coats of paper, pasted one on the other, and so on, according to the diameters of the tubes, increasing in number of coats as the size may be augmented, applying last of all the coat of vellum. The above-mentioned number of four coats of paper is found to succeed for tubes to the extent of two inches in diameter, beyond which a coat or coats of post or writing paper may be added, as shall be found requisite. The substance so composed is formed into tubes, by being pasted on moulds or treblets made of brass or compound metal, which are adapted to the implement called a draw bench, hitherto used for drawing brass or metal only, and drawing the same through brass holes made for that purpose. The tubes are tempered to a certain hardness by drawing them through one, two, or more holes, which is absolutely necessary to make the tubes cylindrical round, and of a true form. It also renders them, by the correctness of their shape, fit to receive brass or metal rims, rings, and screws.

The side of the first coat of paper, which I call the water coat, *viz.* that which is intended to form the inside surfaces of the tubes, is stained black previous to its being put on the treblet. Any black stain may be used, but I prefer the following preparation, *viz.* Indian ink with common writing ink, in the proportion of a quarter of an ounce of the former to a gill of the latter, to which may be added about half a quarter of an ounce of gum, well dissolved in about half a gill of water. This preparation is laid on the said first coat of paper with a brush; and the said first coat of paper, while wet with it, is placed on the treblet, which is previously greased with suet, or other grease.

The first coat of paper, or water coat, may, however, be moistened with water only, previous to its being placed on the treblet; and in that case the inside surface of the tube may be afterwards stained black with the said preparation, by means of a brush dipped in it being drawn through the tube.

The next, or second coat of post or writing paper, is to be well moistened with paste on both sides, and then laid on the water coat. This should be accomplished while the latter is yet moist.

The brown or blue paper is laid on the second coat after the same manner, and there the work ceases till the coats so pasted together are dry and hard enough to admit of its surface being levelled, which is effected by filing. This process is necessary, in order to correct the inequalities, and remove the gritty substances which are generally to be found in paper, but especially in the brown or blue sorts. When the last-mentioned surface is made smooth, the next coat of post paper should be pasted thereon, and last of all the vellum. Care should be taken to incorporate the paste well with the paper;

and in the stiffer sorts of paper it would be proper to moisten them in water, first of all squeezing the same out by pressure previous to the application of the paste: this precaution should be observed with the outside or vellum coat also. The paste is made in the usual manner, with the exception, that a small portion of powdered resin (about a quarter of an ounce to a pint) should be put into it, in order to stiffen it.

The treblets are for the most part made hollow; in the larger sizes they are cored through in the casting; in the smaller ditto they are drilled or bored; and in the smallest of all they are left solid. The reason for their being made hollow is in one respect to reduce the quantity of brass or metal, thereby to save expense. In another point of view, to enable the workman to place therein an iron heater, made red hot, by the aid of which artificial heat the moisture contained in the different coats is dried with tolerable quickness, the same is thereby sooner prepared for the draw-bench, and the whole of the subsequent mechanical process expedited.

A, Fig. 1, (Plate VIII.) in the schedule or drawing hereunto annexed exhibits a view of one end of the treblet, made hollow, to receive the heater.

Fig. 2 the other, or that end called the tang, which is fitted into the end B of the treblet, Fig. 1, either by a screw or with plain surfaces, and then pinned; a mode adopted in preference to soldering, which would soften the metal.

At C, Fig. 2, is represented a groove, made to receive a bandage of string. This is applied to each coat while in a moist state, in order that the same should acquire the form of the groove, which being effected, it is then removed till the last coat is put on, when it is bound tight, and suffered to remain till the process of drawing is performed. It will appear obvious, that this plan is adopted in order to provide against, and to resist, the great force employed in drawing the tubes through the required holes.

D, in the same figure, represents the slit to receive the key that passes into the treblet through the tongs or chops at the end of the chain appertaining to the draw-bench.

Fig. 3 exhibits the form of the heater.

Moistened soap or grease should be applied to the surfaces of the holes, and the same to the surfaces of the vellum. Good starch, in a fluid state, answers the purpose equally well, and in some instances is to be preferred.

The method of mounting and putting the tubes together is as follows. The different sized tubes being perfected, they are to be removed from the treblets, which a gentle pull will effect. They are then given into the hands of the turner, who places them in succession on chucks in his lathe, and cuts them to their required lengths.

On one end, within the tube, Fig. 4, is cemented or glued a single coat or ring of vellum, about three or four sixteenths of an inch in breadth, or more if required, as at E at the other end. On the outside is cemented or glued, or otherwise affixed, a substance, intended to form a cylinder of a larger size than the tube on which it is placed, usually termed a spring, which is fitted to its next size or neighbouring tube wherein the same slides. This is made with grooves or recesses to receive cloth, as at F, Fig. 5. The vehicle to sustain or carry the cloth may be made of brass or other metal, or of box or other wood, or of leather; but leather is found more simple in its application than either brass or wood, and operates with greater certainty, and is therefore preferred. The leather is procured of a thickness to admit of being turned true and cylindrical, is secured on the tube by being cemented or glued with wooden or brass pins, as at Fig. 4, where it is nicely fitted by the turner to the next and adjacent tube. To compleat the construction of the tube, at that end a thin ring of brass or metal is fitted to the inside, immediately under the cylinder or spring, as a support to the spring, its breadth varying. It may be one eighth, three sixteenths, one fourth, and so on to half an inch if found necessary. Rings of wood are made which likewise answer a similar purpose, and are frequently used, but are neither so neat nor so tight. This ring is merely fitted in tight; it may, however, be glued or secured with pins, or in any other manner if required. Within the vellum ring at the other end is affixed a screw ring of brass, as at H, Fig. 6. This is screwed, glued, and pinned; it serves to strengthen that end of the tube, and from being milled on the edge becomes an ornament to the instrument. It operates also as a check or stop when the glass is being shut or closed.

The more effectually to prevent friction, which might injure the painted or otherwise ornamented surfaces of the tube, I augment the thickness of the cylinder or spring G, Fig. 4, on which the tubes slide just so much as to clear the two rings E, Fig. 4, and H, Fig. 6, *viz.* the one of vellum and the other of brass, leaving sufficient windage or space between the inner surface of the latter and the painted or otherwise ornamented outside surfaces of the sliding tubes. There is another species of screw ring, as represented at I, Fig. 7, which, instead of screwing into the inside of the tube, affixes to the outside, and enables the person possessing one of these telescopes to take the same to pieces at the eye end. The mode before mentioned, as seen at H, Fig. 6, is, however,

ever, the best adapted for general use, and the strongest. By that mode the telescope will be taken to pieces from the object end. The stops or diaphragms for contracting the aperture of light are formed of box wood, brass, or metal; I usually prefer brass.

The cell containing the object glass or glasses I form of ivory or wood for lightness: I omit the cover usually placed at that end for the same reason. The same in some instances is lined with a thin brass ring, and the counter screw, which encloses and secures the glasses, I usually make of brass. The head of the instrument is made also of ivory or wood for lightness; box wood is generally preferred. I have given to this part of the telescope a new form, which I occasionally paint, gild, varnish, and otherwise ornament. I have also discontinued the use of the sliding shutter at the head of the telescope, as it was constantly being out of repair, and from its being retained gave to the head a clumsy appearance.

I prefer the foregoing method of constructing the cell for, and placing, the eye glass and object glass; but the cover and the old shutter alluded to may nevertheless be applied to these instruments if thought proper. The inner tubes containing the eye glasses may be constructed after the same manner as the tubes of the telescopes, namely of paper and vellum combined with brass or metal rings or rims, or they may be made wholly of brass; the latter I in general prefer, and for the most part adopt.

The second part of my invention consists of the introduction of an additional glass in a new manner into telescopes of small size, usually called prospect glasses, whereby the extent of view, and also the magnifying power, may be varied to a greater degree than by the instruments of this sort now used; and telescopes constructed upon this principle may be used in the theatres or other public places as opera glasses; and the additional glass is to be so placed in one of the tubes as to be at or about the centre of the instrument when all the tubes of which it is composed are drawn out. This additional or intermediate glass must be a magnifying glass, properly adapted to the focus of the object glass; and it may be either double convex, plane convex, or concave convex.

For viewing prospects, or very distant objects, all the tubes are to be drawn out to a length suited to the eye-sight and the distance of the object. When this telescope is used as an opera glass, the tube in which the said additional or intermediate glass is fixed is not to be drawn out from the largest tube, or that which contains the object glass; nor, in case the instrument consists of more than three tubes, are any of those to be drawn out which are between the tube containing the said additional glass and the tube containing the object glass.

The whole length when all the tubes are drawn out may be about six or seven inches.

The largest tube of this instrument being that which contains the object glass, may also be used as the lower tube of a longer telescope, and thereby expense will be saved to such persons as may choose to purchase both.

The method of applying the said largest tube to a longer telescope, and removing it to the prospect or opera glass, is as follows: Letter K, Fig. 8, in the drawing hereunto annexed, represents the said third or largest tube as annexed in the usual way to the screw ring at M of the long telescope L. This tube is disengaged by unscrewing the joint at M, and which will be effected by holding one part still and turning the other. When the tube K is thus removed, apply it to the screw ring at N, Fig. 9.

In witness whereof, &c.

Specification

Specification of the Patent granted to DAVID MUSHET, *of Coleford, in the County of Gloucester, Iron-master; for an Improvement or Improvements in the Process or Processes of making or manufacturing Iron.*

Dated July 25, 1815.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said David Mushet do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, are described and ascertained as follows; that is to say: I have discovered a method, means, or process, for refining pig or cast iron in a blast furnace, to which, when used for this purpose, I give the name of the smelting refinery. By my said invention the whole or greater part of the metallic contents of the cinder, slag, or scoria, produced from the common refinery; of the slags, cinder, or scoria, that falls at the puddling or roughing rollers; of the slag, scoria, or cinder, commonly called hammer slag; of the slag, scoria, or cinder, that is produced from the mill balling and puddling furnaces; of the scale or shale that is produced at the finishing rollers; and of any other refuse containing iron, formed in any stage of the process or processes of making or manufacturing bar or malleable iron of every description; is recovered or revived, and brought directly into the state of what is known in the trade by the name of finers iron or metal, of a quality fit for the purposes of the puddling furnace or stamping fire; and, in effecting this, I make use of the superfluous carbon or coaly matter of a portion of pig or cast iron in reviving and reducing the iron contained in the said various slags, scoria, cinder, scale, or other refuse products containing iron, converting at the same time the iron contained in the pig or cast iron into finers iron or metal.

When about to work with these materials, I proceed in the following manner. I take from three hundred to four hundred pounds of well-burnt coke, charcoal, or other fuel, alone or in mixture; six hundred pounds of pig or cast iron, reduced into any convenient size or form; one hundred and eighty to two hundred and forty pounds of the various slags, scoria, cinder, scale, or other refuse containing iron, or any one or more of them. To these I add from one hundred to one hundred and fifty pounds of limestone, or in that proportion, or from forty to one hundred and twenty pounds of burnt lime; which last I generally prefer. These different items I denominate a charge, which at proper intervals is filled into the furnace or smelting refinery, previously prepared and heated for its reception according to the ordinary and common methods practized at iron-works; but the charge may be increased or diminished according to circumstances, due regard being paid to the aforesaid proportions. When the charge or charges successively reach the hearth of the furnace, the metallic parts sink to the bottom, and become covered with the earthy matters of the charge, in the state of glass or scoria; no part of this should be allowed to flow or run off (as is now the case at blast furnaces) till the furnace is tapped. The glass or scoria then follows the metal, and I find it convenient and advantageous to allow it to form a covering over the metal in the box or mould prepared for its reception. If after the first or second tapping the metal is found not sufficiently decarbonated, or, in the language of the manufactory, "not high enough blown," I gradually reduce the proportion of coke, charcoal, or other fuel; or I keep adding from time to time a larger quantity of the said slags, cinders, scoria, scale, or other refuse, with a proportionate quantity of lime, till the quality of the metal is sufficiently refined for the purposes of the puddling furnace or stamping fire. At this particular stage the process may be deemed complete, and the whole expense for labour and fuel will be found not materially to exceed that of the common refinery; which operation consists chiefly in burning out a part of the carbon or coaly matter contained in the pig or cast iron, by which a loss is sustained of from two and a half to three hundred weight in the ton. But, as in my process, I make use of this carbon to revive or reduce the iron contained in the said slags, scoria, cinders, scale, or other refuse, products of the forge, I generally obtain after the rate of twenty-four to twenty-five hundred weight of finers iron or metal for each ton of pig or cast iron introduced into the smelting refinery furnace.

But, secondly, in situations where the operations of the forge are not carried on, I make use of iron ores or iron stones in mixture with pig or cast iron, in any convenient shape or form for refining, or converting the metallic contents of the same into finers iron or metal; and my mode of operating with these substances is similar to that above described with pig or cast iron, and the said slags, scoria, scale, cinders, or other refuse containing iron, the materials in their proper proportions being introduced into the smelting refinery furnace, and the process conducted as above described. Iron ores and iron stones may be used for refining or decarbonating the pig or cast iron, either raw or roasted; and the proportion of lime necessary to be added to each charge ought to be the same as is added in the common process of pig iron making in the blast furnace, except in cases where iron ores or iron stones are used containing fifty-five *per cent.*

or

or more of iron, such ores admitting of a reduction of the quantity of lime or limestone in proportion as the earthy matter in them decreases.

Thirdly. The foregoing modes of manipulation are convenient in situations where pig or cast iron is at hand, but where it may be otherwise, or it may be wished to avoid the using of pig or cast iron, I apply my said invention in the following manner, to revive and recover the iron contained in the following substances, and to bring it directly into the state of refined iron or finers metal in the smelting refinery furnace, without any mixture of pig or cast iron, as described in the foregoing process; that is to say, if the materials are slags, scoria, or cinder, of the mill balling or pudling furnaces, of the pudling or roughing rollers, of the blooming or stamping hammer, commonly called hammer slag, of the common refinery furnace, or the scale that is formed in the making, rolling, or finishing of bar or other malleable iron, (the smelting refinery furnace being previously heated,) I take from three hundred and fifty to four hundred and fifty pounds of coke, charcoal, or other fuel, separately or in mixture, from three hundred to three hundred and fifty pounds of the above-described forge refuse, from one hundred to one hundred and twenty pounds of burnt lime, or from one hundred and forty to one hundred and seventy pounds of limestone, but I prefer the burnt lime. This charge, or any other quantity similarly proportioned, I introduce from time to time into the smelting refinery furnace, without any mixture of pig or cast iron. When the charge reaches the hearth of the furnace the metal falls to the bottom, covered with the earthy matters, in the state of scoria or glass. This should be carefully kept over the iron till the same is run from the furnace, and not allowed to run off from time to time, as in the common mode of pig iron making. If, after repeated tappings the iron is found not to be sufficiently decarbonated or refined, a portion of the coke, charcoal, or other fuel, is to be gradually reduced from each charge, as described in the former processes, or a larger quantity of the said slags or refuse containing iron added till the metal is obtained of the requisite quality. By following this mode of operation finers metal, or refined iron, may be made from a general mixture of the slags, scoria, cinder, scale, or other refuse of the forge, as they are produced; but it also may be made from any one or more of them, in any or in every proportion as to mixture and quantity, by accommodating the proportion of lime in some measure, according to the following scale. Mill scale, one sixth its weight of burnt lime, mill or balling furnace, slag, scoria, or cinder, one-third its weight of burnt lime, pudling furnace, slag, scoria, or cinder, one-half its weight of burnt lime, pudling or roughing rollers and hammer, slag, scoria, or cinder, one-fourth its weight of burnt lime, finery, slag, scoria, or cinder one-fourth its weight of burnt lime. These proportions of burnt lime to forge slags, scoria, cinder, or scale, will generally be found to answer where a moderate combination of earthy matter enters into their composition, and into that of the coke, charcoal, or other fuel; but instances may occur where a greater or less quantity will be necessary than that given in the above proportions.

Fourthly. Where it is desirable that refiners iron or metal, as it is called, should be produced directly from iron stones or ores, without employing pig or cast iron, I proceed in the following manner: the smelting refinery being properly prepared, I take from three hundred to four hundred pounds of coke, charcoal, or other fuel, separately or in mixture, from three hundred to three hundred and fifty pounds of iron stone or iron ore reduced to small fragments with the same quantity of lime by weight as would be necessary to flux the iron stone or ore in the common smelting furnace for the production of pig or cast iron. This, or any other quantity similarly proportioned, I introduce from time to time into the smelting refinery furnace, where the same operation takes place that has been already described; care being taken to keep the whole of the vitrified matter, glass, or scoria, formed from the lime and earthy matters of the ore over the fluid metal till the same is tapped out, as above described. In this, as in the processes formerly detailed, should the metal thus obtained directly from the iron stone or ore be found not sufficiently decarbonated, or not "enough blown," the proportion of coke, charcoal, or other fuel, in the charge is to be gradually reduced, or the quantity of iron stone or ores increased, till the metal is produced of a proper quality, as before directed. When I make use of iron stones I prefer the same coasted, and when iron ores, richer in iron than those commonly smelted at the iron-works in this country, are made use of, no other earthy matter is necessary, and no more lime than is requisite to unite with the earths contained in the said ores to effect a separation of their metallic contents. But in cases or in situations where the iron stones or ores are already united with lime, properly denominated calcareous ores of iron, (such as are found in his Majesty's Forest of Dean,) instead of adding lime to the charge of coke, charcoal, or other fuel, and iron stone or iron ore, I add clay, or clay shale, in the raw or burnt state, though I prefer using it in the latter. Or I add argillaceous or common iron stone, in quantity or quantities proportioned to the calcareous earths contained in the ores, which proportions the nature of the materials

rials alone can determine. When I intend to smelt ores for the production of finers metal or refined iron that contain fifty-five *per cent.* of iron and upwards, I prefer using four hundred and fifty pounds of coke, charcoal, or other fuel, to three hundred pounds of ore, besides the proper proportion of lime, clay, clay shale, or argillaceous or common iron stone, as the nature of the ores may require. And should I find the metal not sufficiently decarbonated I reduce the quantity of coke, charcoal, or other fuel, or increase the quantity of ore to each charge, till the iron is produced of the requisite quality.

Fifthly. As it may sometimes be convenient to use slags, scoria, or other refuse containing iron, at the same time with iron stones or iron ores, it is proper that I should mention that this may be done by any intelligent operator, either with or without pig or cast iron, if he attends to the directions before given, taking care to proportion the flux to the metallic and earthy contents of the charge, and observing, as a general rule, that not only in this case, but in all the previously-described modes of using my said invention, the metal in the hearth of the furnace is to be protected from the injurious effects of the blast by a large body of scoria or vitrified matter, say to the depth of from fifteen to eighteen inches or more, before tapping. I may farther remark here, that though I have directed the furnace to be tapped from time to time, *viz.* when the metal has reached a certain height in the hearth, (beyond which the depth of the incumbent vitrified matter would be too much reduced,) yet an intelligent operator may work otherwise, by having a hearth of sufficient depth under the twyre, and allowing part of the scoria to run off, but still leaving a sufficient depth to protect the iron, by which means he will be enabled to run off a greater quantity of metal at one tapping.

In all the foregoing processes, if the first proportion of materials is in the furnace, and the operation otherwise well conducted, the glass or ssoria will be found of a greenish colour, possessed of some transparency.

Sixthly. In making and manufacturing finers metal or refined iron, in the smelting refinery furnace, by any of the methods or processes, or with any of the substances or mixtures of them before enumerated, if I find the materials sufficiently fusible for the purpose, I withdraw a greater quantity of the coke, charcoal, or other fuel from each charge than is necessary in the making of what is commonly denominated and understood in the iron trade by the term finers iron or metal; or I add a greater quantity to each charge of slags, scoria, cinder, scale, or other refuse containing iron or iron stones or iron ores, with the proportionate quantity of lime or flux, till I obtain the degree of decarbonation or refinement wished for. This I do to lessen the waste of the iron in the subsequent operations of converting it into bar or malleable iron, it being a fact well known in the trade, that the higher the iron is refined or *blown* the less is the loss or waste sustained in the subsequent manipulations of the forge, taking care to keep an equal or even a greater depth of glass or scoria over the metal in the furnace, as before directed.

Seventhly. I apply my said invention to the manufacture of cast or pig iron, by keeping the surface of the metal in the hearth protected by a sufficient depth of scoria or vitrified matter, and drawing off the metal from below the same instead of allowing it to flow off above, as in the common method of working. And I have ascertained that the manufacture of pig or cast iron in this manner requires a less powerful blast than is usually necessary, while at the same time ores of a richer quality may be used in the furnace than can be reduced with advantage in the mode of making pig or cast iron usually followed.

I may further remark, that in all the foregoing processes it is advantageous to have all the materials, excepting the coke, charcoal, or other fuel, broken or formed into fragments so small that the whole may pass through a sieve, whose openings do not exceed three quarters of an inch; one great aim (both as to economy and the quality of the product) being the exposure of as much surface as possible of the different materials to the mutual action of each other, and of the fuel.

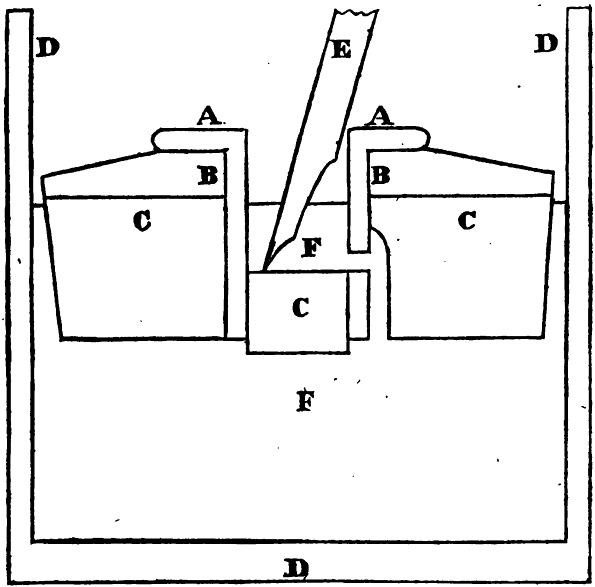
In the preceding description of my invention, and the processes by which I carry the same into effect, I have sometimes mentioned lime only as the flux, being that which I generally prefer, though other fusible earths or mixtures of earths, or calcareous iron ores, may be used; but in my opinion not with equal advantage.

Lastly. As to the furnace proper for the foregoing processes, it is sufficient to say, that in its general form it differs not from a common blast-furnace, excepting in the shape of the hearth, which for my invention I prefer having of a square or a cylindric form. As to its size, I prefer one of smaller dimensions than the common blast-furnace now in use, *viz.* from twenty to thirty feet in height, from six to eight feet diameter at the boshes or widest part, and from two to three feet diameter at the top, the hearth five or six feet high, and from two and a half to four feet in diameter.

In witness whereof, &c.

Description of an Ink-Glass, upon a simple, cheap, and useful Plan; in which the Supply of Ink is regulated by Means of a Float. Communicated by the Inventor, THOMAS N. PARKER, *Esq.*

With a Wood Engraving.



REFERENCE TO THE ENGRAVING.

A A, glass, in the form of the neck of a bottle.

B B, a piece of close-grained wood, too heavy in itself for floating the glass A A.

C C C, cork, of such dimensions as may be sufficient for floating the glass A A, in the manner represented.

D D D, a cylindrical glass receiver for the ink, like a beer glass, of any convenient size.

E, the pen.

F F, the ink.

Advantages

Advantages of the Plan.

The float having been once adjusted, and proved in water,

You cannot take up too much nor too little ink in a pen.

The point of the pen touches only a soft and clean surface of cork.

The sediment of the ink sinks to the bottom of the vessel, with which the pen has no communication.

The supply of ink is regular, and not affected by the temperature of the air, as in fountain ink glasses.

The ink being almost entirely excluded from the air, will not lose its colour.

The supply of ink will continue the same until the contents of the vessel be nearly exhausted.

The writing paper is not likely to be blotted, nor the fingers stained.

Further Description of the Float, &c.

Having procured the little cylinder of glass, of half an inch diameter within, a hole is to be drilled through one side of it, and a part of the cork cut away; to admit the supply of ink from below.

A piece of alder, or some lighter wood, turned in a lathe, of the form described in the engraving, will answer the purpose, without either glass or cork, excepting the stopper for receiving the pen, which should always be made of cork.

The upper part of the float should nearly fit the glass, but the lower part of it must be smaller; otherwise the float will adhere to one side of the glass, and not answer quite so well.

If the wood used for the float be not well seasoned, it will warp and break the glass; and in all cases it will swell a little after it is wet, which must be attended to, and considered in fitting the float to the glass.

I think that the float may be made of hollow porcelain, rather *too light* at first, having a small hole in some part, whereby beeswax might be introduced for adjusting the weight of the float, and then fixed by heating the float and melting the wax; the inside of the porcelain float should be left rough, or of such a form as will hold the wax at the bottom; and when once adjusted, the hole must be stopped up and made water-proof, by means best known to china manufacturers.

The float might as well be made in glass, and perhaps glass will turn out to be the best material. Suppose that a hollow float be blown in glass of the form described, it might be made *too heavy* at first, and be ground in a lathe until reduced to the exact weight and form desired.

The reason why I would make the porcelain float *too light*, and the glass float *too heavy* at first, is merely this; that a sufficient substance could be preserved in the glass, which in the former opaque body would be uncertain; but the manufacturers can effect the purpose in the manner most convenient to themselves.

This ink-glass is best adapted for the counting-house, or where it is not to be caried about: but when reduced in size, it may be used any where with perfect safety, provided that the stand, in case of accident, will hold the ink.

I have made the floats of copper, brass, tin, and iron, each of which appeared to answer very well at first, but they soon destroyed the colour of the ink; and although I covered them with a sort of blacking used by brasiers, they still spoiled the ink.

The black ink-stands of potters' ware are said to injure the colour of the ink, but I am not aware of any objection to them when glazed.

The experiment as to this ink-glass may be tried in a rough but equally effectual manner, at the cost of one or two pence, as thus: take a piece of glass tube, of half an inch diameter within, such as is used for containing the spirits in spirit-levels; cut off one inch in length with a file, and grind down the sharp edges on a stone with water; file a hole on one side, at about equal distance from the top and bottom, or rather lower; take a cork, such as is used for the bung of a cask, and cut off half an inch of it in thickness; bore a hole through the centre of the cork, clear the hole with a hot iron, and fit it to the little glass tube; cut the cork to fit the glass receiver; half fill the glass receiver with ink, put the float therein, and the ink-glass will be complete.

I may venture to say, that wherever this simple contrivance is once fairly tried, it will not be exchanged for any other kind of ink-glass which I have ever seen; and the expense is so trifling, that any person making a quantity of them together, in the rough manner last mentioned, the materials and labour would not be worth more than from one to two shillings *per* dozen for the floats: and really the advantages of the plan, as I have already enumerated, and as I have experienced for two or three years, are such as, I confidently believe, will cause it ere long to be generally adopted.

Recipe for making Ink.

It may be acceptable, that a description of a good ink-glass should be accompanied by a good recipe for making ink; this is principally taken from " The Encyclopædia

Britannica,"

Britannica," under the article *Ink,* and I have used it for many years.

12 oz. galls, powdered; 4 oz. logwood, ditto; 4 oz. green vitriol; 4 oz. gum arabic; 1 wine gallon of vinegar, or water, or half of each.

The above ingredients may be put together at once, stirred up occasionally for a week or ten days, then strained, bottled, and corked.

The ingredients would perhaps go further, or make the ink of a darker colour, if half the quantity of vinegar and water were put first to the galls and logwood, and poured off in a few days: then put the remainder of the vinegar and water to the galls and logwood for a few days longer, stirring up the mixture as before, and at last strain and pour off the ink. The vitriol and gum may best be added to the menstruum after it is separated from the sediment, which latter ingredients will soon be dissolved: stir the mixture occasionally for a few days, and when the remaining sediment is fallen to the bottom of the vessel the ink will be fit for use.

I wish to put this invention at once into the hands of several china and glass manufacturers, in the hope, that some ingenious person engaged in one of those lines of business will speedily complete, what I have in an imperfect manner made useful.

Sweeney, August 12, 1816.

On

On Soils: their constituent Parts. On the Analysis of Soils. Of the Uses of the Soil. Of the Rocks and Strata found beneath Soils. Of the Improvement of Soil.

By Sir HUMPHRY DAVY, LL.D. F.R.S. L.&E., &c.

(Concluded from Page 175.)

THE extract from decomposing vegetable matter when boiled with pipe-clay or chalk, forms a combination by which the vegetable matter is rendered more difficult of decomposition and of solution. Pure silica and siliceous sands have little action of this kind; and the soils which contain the most alumina and carbonate of lime are those which act with the greatest chemical energy in preserving manures. Such soils merit the appellation which is commonly given to them of rich soils; for the vegetable nourishment is long preserved in them, unless taken up by the organs of plants. Siliceous sands, on the contrary, deserve the term hungry, which is commonly applied to them; for the vegetable and animal matters they contain not being attracted by the earthy constituent parts of the soil, are more liable to be decomposed by the action of the atmosphere, or carried off from them by water.

In most of the black and brown rich vegetable moulds the earths seem to be in combination with a peculiar extractive matter, afforded during the decomposition of vegetables: this is slowly taken up, or attracted from the earths by water, and appears to constitute a prime cause of the fertility of the soil.

The standard of fertility of soils for different plants must vary with the climate; and must be particularly influenced by the quantity of rain.

The power of soils to absorb moisture ought to be much greater in warm or dry counties than in cold and moist ones; and the quantity of clay, or vegetable or animal matter they contain, greater. Soils also on declivities ought to be more absorbent than in plains or in the bottom of vallies. Their productiveness likewise is influenced by the nature of the subsoil or the stratum on which they rest.

When soils are immediately situated upon a bed of rock or stone they are much sooner rendered dry by evaporation than where the subsoil is of clay or marle; and a prime cause of the great fertility of the land in the moist climate of Ireland is the proximity of the rocky strata to the soil.

A clayey subsoil will sometimes be of material advantage to a sandy soil; and in this case it will retain moisture in such a manner as to be capable of supplying that lost by the earth above, in consequence of evaporation, or the consumption of it by plants.

A sandy or gravelly subsoil often corrects the imperfections of too great a degree of absorbent power in the true soil.

In calcareous countries, where the surface is a species of marle, the soil is often found only a few inches above the limestone; and its fertility is not impaired by the proximity of the rock; though in a less absorbent soil this situation would occasion barrenness; and the sandstone and limestone hills in Derbyshire and North Wales may be easily distinguished at a distance in summer by the different tints of the vegetation. The grass on the sandstone hills usually appears brown and burnt up; that on the limestone hills flourishing and green.

In devoting the different parts of an estate to the necessary crops, it is perfectly evident, from what has been said, that no general principle can be laid down, except when all the circumstances of the nature, composition, and situation of the soil and subsoil are known.

The methods of cultivation likewise must be different for different soils. The same practice which will be excellent in one case may be destructive in another.

Deep ploughing may be a very profitable practice in a rich thick soil; and in a fertile shallow soil, situated upon cold clay or sandy subsoil, it may be extremely prejudicial.

In a moist climate, where the quantity of rain that falls annually equals from forty to sixty inches, as in Lancashire, Cornwall, and some parts of Ireland, a siliceous sandy soil is much more productive than in dry districts; and in such situations wheat and beans will require a less coherent and absorbent soil than in drier situations; and plants having bulbous roots will flourish in a soil containing as much as fourteen parts out of fifteen of sand.

Even the exhausting powers of crops will be influenced by like circumstances. In cases where plants cannot absorb sufficient moisture, they must take up more manure. And in Ireland, Cornwall, and the Western Highlands of Scotland, corn will exhaust less than in dry inland situations. Oats, particularly in dry climates, are impoverishing in a much higher degree than in moist ones.

Soils appear to have been originally produced in consequence of the decomposition of rocks and strata. It often happens, that soils are found in an unaltered state upon the rocks from which they were derived. It is easy to form an idea of the manner in which rocks are converted into soils, by referring to the instance of *soft granite*, or *porcelain granite*. This substance consists of three ingredients, quartz, feldspar, and mica. The quartz is almost pure siliceous earth, in a crystalline form. The feldspar and mica are very compounded substances; both contain silica, alumina, and oxyd of iron; in the feldspar there is usually lime and potassa; in the mica, lime and magnesia.

When a granitic rock of this kind has been long exposed to the influence of air and water, the lime and the potassa contained in its constituent parts are acted upon by water or carbonic acid; and the oxyd of iron, which is almost always in its least oxyded state, tends to combine with more oxygen; the consequence is, that the feldspar decomposes, and likewise the mica; but the first the most rapidly. The feldspar, which is as it were the cement of the stone, forms a fine clay: the mica partially decomposed mixes with it as sand; and the undecomposed quartz appears as gravel, or sand of different degrees of fineness.

As soon as the smallest layer of earth is formed on the surface of a rock, the seeds of lichens, mosses, and other imperfect vegetables which are constantly floating in the atmosphere, and which have made it their resting place, begin to vegetate; their death, decomposition, and decay, afford a certain quantity of organizable matter, which mixes with the earthy materials of the rock; in this improved soil more perfect plants are capable of subsisting; these in their turn absorb nourishment from water and the atmosphere; and after perishing afford new materials to those already provided: the decomposition of the rock still continues; and at length, by such slow and gradual processes, a soil is formed in which even forest trees can fix their roots, and which is fitted to reward the labours of the cultivator.

In instances where successive generations of vegetables have grown upon a soil, unless part of their produce has been carried off by man, or consumed by animals, the vegetable matter increases in such a proportion, that the soil approaches to a peat in its nature; and if, in a situation where it can receive water from a higher district, it becomes spongy, and permeated with that fluid, and is gradually rendered incapable of supporting the nobler classes of vegetables.

Many peat-mosses seem to have been formed by the destruction of forests, in consequence of the imprudent use of the hatchet by the early cultivators of the country in which they exist: when the trees are felled in the outskirts of a wood, those in the interior are exposed to the influence of the winds; and having been accustomed to shelter, become unhealthy, and die in their new situation; and their leaves and branches gradually decomposing, produce a stratum of vegetable matter. In many of the great bogs in Ireland and Scotland, the larger trees that are found in the out-skirts of them bear the marks of having been felled. In the interior, few entire trees are found; and the cause is, probably, that they fell by gradual decay; and that the fermentation and decomposition of the vegetable matter was most rapid where it was in the greatest quantity.

Lakes and pools of water are sometimes filled up by the accumulation of the remains of aquatic plants; and in this case a sort of spurious peat is formed. The fermentation in these cases, however, seems to be of a different kind. Much more gaseous matter is evolved; and the neighbourhood of morasses, in which aquatic vegetables decompose, is usually aguish and unhealthy; whilst that of the true peat, or peat formed on soils originally dry, is always salubrious.

The earthy matter of peats is uniformly analogous to that of the stratum on which they repose; the plants which have formed them must have derived the earths that they contained from this stratum. Thus, in Wiltshire and Berkshire, where the stratum below the peat is chalk, calcareous earth abounds in the ashes, and very little alumina and silica. They likewise contain much oxyd of iron and gypsum, both of which may be derived from the decomposition of the pyrites, so abundant in chalk.

Different specimens of peat that I have burnt from the granitic and schistose soils of different parts of these islands, have always given ashes principally siliceous and aluminous; and a specimen of peat, from the county of Antrim, gave ashes which afforded very nearly the same constituents as the great basaltic stratum of the county.

Poor and hungry soils, such as are produced from the decomposition of granitic and sandstone rocks, remain very often for ages with only a thin covering of vegetation. Soils from the decomposition of limestone, chalks, and basalts, are often clothed by nature with the perennial grasses; and afford, when ploughed up, a rich bed of vegetation for every species of cultivated plant.

Rocks and strata from which soils have been derived, and those which compose the more interior solid parts of the globe, are arranged in a certain order; and as it often happens that strata very different in their nature are associated together, and that the strata immediately beneath the soil contain materials which may be of use for improving it, a general view of the nature and position of rocks and strata in nature, will not, I trust, be unacceptable to the scientific farmer.

Rocks are generally divided by geologists into two grand divisions, distinguished by the names of *primary* and *secondary*.

The primary rocks are composed of pure crystalline matter, and contain no fragments of other rocks.

The secondary rocks, or strata, consist only partly of crystalline matter; contain fragments of other rocks or strata; often abound in the remains of vegetables and marine animals; and sometimes contain the remains of land animals.

The primary rocks are generally arranged in large masses, or in layers vertical, or more or less inclined to the horizon.

The secondary rocks are usually disposed in strata or layers, parallel, or nearly parallel, to the horizon.

The number of primary rocks which are commonly observed in nature are eight.

First, *granite*, which, as has been mentioned, is composed of quartz, feldspar, and mica; when these bodies are arranged in regular layers in the rock, it is called *gneis*.

Second, *micaceous schistus*, which is composed of quartz and mica arranged in layers, which are usually curvilineal.

Third, *sienite*, which consists of the substance called hornblende and feldspar.

Fourth, *serpentine*, which is constituted by feldspar and a body named resplendent hornblende; and their separate crystals are often so small as to give the stone a uniform appearance: this rock abounds in veins of a substance called *steatite*, or *soap rock*.

Fifth, *porphyry*, which consists of crystals of feldspar, embedded in the same material, but usually of a different colour.

Sixth, *granular marble*, which consists entirely of crystals of carbonate of lime; and which, when its colour is white, and texture fine, is the substance used by statuaries.

Seventh, *chlorite schist*, which consists of chlorite, a green or gray substance somewhat analogous to mica and feldspar.

Eight, *quartzose rock,* which is composed of quartz in a granular form, sometimes united to small quantities of the crystalline elements, which have been mentioned as belonging to the other rocks.

The secondary rocks are more numerous than the primary; but twelve varieties include all that are usually found in these islands.

First, *grauwacke,* which consists of fragments of quartz, or chlorite schist, embedded in a cement, principally composed of feldspar.

Second, *siliceous sandstone,* which is composed of fine quartz or sand, united by a siliceous cement.

Third, *limestone,* consisting of carbonate of lime, more compact in its texture than in the granular marble; and often abounding in marine exuvia.

Fourth, *aluminous schist,* or *shale,* consisting of the decomposed materials of different rocks cemented by a small quantity of ferruginous or siliceous matter; and often containing the impressions of vegetables.

Fifth, *calcareous sandstone,* which is calcareous sand, cemented by calcareous matter.

Sixth, *ironstone,* formed of nearly the same materials as aluminous schist, or shale; but containing a much larger quantity of oxyd of iron.

Seventh, *basalt* or *whinstone,* which consists of feldspar and hornblende, with materials derived from the decomposition of the primary rocks; the crystals are generally so small as to give the rock a homogeneous appearance; and it is often disposed in very regular columns, having usually five or six sides.

Eighth, *bituminous* or *common coal.*

Ninth, *gypsum,* the substance so well known by that name, which consists of sulphate of lime; and often contains sand.

Tenth, *rock salt.*

Eleventh, *chalk*, which usually abounds in remains of marine animals, and contains horizontal layers of flints.

Twelfth, *plum-pudding stone*, consisting of pebbles cemented by a ferruginous or siliceous cement.

To describe more particularly the constituent parts of the different rocks and strata will be unnecessary; at any time, indeed, details on this subject are useless, unless the specimens are examined by the eye; and a close inspection and comparison of the different species will in a short time enable the most common observer to distinguish them.

The highest mountains in these islands, and indeed in the whole of the old continent, are constituted by granite; and this rock has likewise been found at the greatest depths to which the industry of man has as yet been able to penetrate! micaceous schist is often found immediately upon granite; serpentine or marble upon micaceous schist: but the order in which the primary rocks are grouped together is various. Marble and serpentine are usually found uppermost; but granite, though it seems to form the foundation of the rocky strata of the globe, is yet sometimes discovered above micaceous schist.

The secondary rocks are always incumbent on the primary; the lowest of them is usually grauwacke: upon this, limestone or sandstone is often found; coal generally occurs between sandstone or shale; basalt often exists above sandstone and limestone; rock salt almost always occurs associated with red sandstone and gypsum. Coal, basalt, sandstone and limestone, are often arranged in different alternate layers, of no considerable thickness, so as to form a great extent of country. In a depth of less than 500 yards, 80 of these different alternate strata have been counted.

The veins which afford metallic substances are fissures more or less vertical, filled with a material different from the rock in which they exist. This material is almost always crystalline; and usually consists of calcareous spar, fluor spar, quartz, or heavy spar, either separate or together. The metallic substances are generally dispersed through, or confusedly mixed with, these crystalline bodies. The veins in hard granite seldom afford much useful metal; but in the veins in soft granite, and in gneis, tin, copper, and lead are found. Copper and iron are the only metals usually found in the veins in serpentine. Micaceous schist, sienite, and granular marble, are seldom metalliferous rocks. Lead, tin, copper, iron, and many other metals, are found in the veins in chlorite schist. Grauwacke, when it contains few fragments, and exists in large masses, is often a metalliferous rock. The precious metals, likewise iron, lead, and antimony, are found in it; and sometimes it contains veins or masses of *stone coal*, or coal free from bitumen. Limestone is the great metalliferous rock of the secondary family; and lead and copper are the metals most usually found in it. No metallic veins have ever been found in shale, chalk, or calcareous sandstone; and they are very rare in basalt and siliceous sandstone.

In cases where veins in rocks are exposed to the atmosphere, indications of the metals they contain may be often gained from their superficial appearance. Whenever fluor spar is found in a vein there is always strong reason to suspect that it is associated with metallic substances. A brown powder at the surface of a vein always indicates iron, and often tin; a pale yellow powder lead; and a green colour in a vein denotes the presence of copper.

It may not be improper to give a general description of the geological constitution of Great Britain and Ireland. Granite forms the great ridge of hills extending from Land's End through Dartmore into Devonshire. The highest rocky strata in Somersetshire are grauwacke and limestone. The Malvern hills are composed of granite, sienite, and porphyry. The highest mountains in Wales are chlorite schist, or grauwacke. Granite occurs at Mount Sorrel in Leicestershire. The great range of the mountains in Cumberland and Westmorland are porphyry, chlorite, schist, and grauwacke; but granite is found at their western boundary. Throughout Scotland the most elevated rocks are granite, sienite, and micaceous schistus. No true secondary formations are found in South Britain, west of Dartmoor; and no basalt south of the Severn. The chalk district extends from the western part of Dorsetshire to the eastern coast of Norfolk. The coal formations abound in the district between Glamorganshire and Derbyshire; and likewise in the secondary strata of Yorkshire, Durham, Westmorland, and Northumberland. Serpentine is found only in three places in Great Britain; near Cape Lizard in Cornwall, Portsoy in Aberdeenshire, and in Ayrshire. Black and grey granular marble is found near Padstow in Cornwall; and other coloured primary marbles exist in the neighbourhood of Plymouth. Coloured primary marbles are abundant in Scotland; and white granular marble is found in the Isle of Sky, in Assynt, and on the banks of Loch Shin in Sutherland: the principal coal formations in Scotland are in Dumbartonshire, Ayrshire, Fifeshire, and on the banks of the Brora in Sutherland. Secondary limestone and sandstone are found in most of the low countries north of the Mendip hills.

In Ireland there are five great associations of primary mountains; the mountains of Morne, in the county of

Down; the mountains of Donegal; those of Mayo and Galway, those of Wicklow, and those of Kerry. The rocks composing the four first of these mountain chains are principally granite, gneis, sienite, micaceous schist, and porphyry. The mountains of Kerry are chiefly constituted by granular quartz and chlorite schist. Coloured marble is found near Killarney; and white marble on the western coast of Donegal.

Limestone and sandstone are the common secondary rocks found south of Dublin. In Sligo, Roscommon, and Leitrim, limestone, sandstone, shale, ironstone, and bituminous coal are found. The secondary hills in these counties are of considerable elevation; and many of them have basaltic summits. The northern coast of Ireland is principally basalt; this rock commonly reposes upon a white limestone, containing layers of flint, and the same fossils as chalk; but it is considerably harder than that rock. There are some instances in this district in which columnar basalt is found above sandstone and shale, alternating with coal. The stone coal of Ireland is principally found in Kilkenny, associated with limestone and grauwacke.

It is evident, from what has been said concerning the production of soils from rocks, that there must be at least as many varieties of soils as there are species of rocks exposed at the surface of the earth; in fact there are many more. Independent of the changes produced by cultivation, and the exertions of human labour, the materials of strata have been mixed together and transported from place to place by various great alterations, that have taken place in the system of our globe, and by the constant operation of water.

To attempt to class soils with scientific accuracy would be a vain labour; the distinctions adopted by farmers are sufficient for the purposes of agriculture; particularly if some degree of precision be adopted in the application of terms. The term sandy, for instance, should never be applied to any soil that does not contain at least seven-eighths of sand; sandy soils that effervesce with acids should be distinguished by the name of calcareous sandy soil, to distinguish them from those that are siliceous. The term clayey soil should not be applied to any land which contains less than one-sixth of impalpable earthy matter, not considerably effervescing with acids. The word loam should be limited to soils containing at least one-third of impalpable earthy matter, copiously effervescing with acids. A soil to be considered as peaty, ought to contain at least one half of vegetable matter.

In cases where the earthy part of a soil evidently consists of the decomposed matter of one particular rock, a name derived from the rock may with propriety be applied to it. Thus, if a fine red earth be found immediately above decomposing basalt, it may be denominated basaltic soil. If fragments of quartz and mica be found abundant in the materials of the soil, which is often the case, it may be denominated granitic soil; and the same principles may be applied to other like instances.

In general, the soils, the materials of which are the most various and heterogeneous, are those called alluvial, or which have been formed from the depositions of rivers; many of them are extremely fertile. I have examined some productive alluvial soils, which have been very different in their composition. The soil which has been mentioned, (page 174,) as very productive, from the banks of the river Parret, in Somersetshire, afforded me eight parts of finely-divided earthy matter, and one part of siliceous sand; and an analysis of the finely-divided matter gave the following results.

360 parts of carbonate of lime.
25 ——— alumina.
20 ——— silica.
8 ——— oxyd of iron.
19 ——— vegetable, animal, and saline matter.

A rich soil from the neighbourhood of the Avon, in the valley of Evesham in Worcestershire, afforded me three-fifths of fine-sand, and two-fifths of impalpable matter; the impalpable matter consisted of

35	Alumina.
41	Silica.
14	Carbonate of lime.
3	Oxyd of iron.
7	Vegetable, animal, and saline matter.

A specimen of good soil from Tiviot Dale, afforded five-sixths of fine siliceous sand, and one-sixth of impalpable matter; which consisted of

41	Alumina.
42	Silica.
4	Carbonate of lime.
5	Oxyd of iron.
8	Vegetable, animal, and saline matter.

A soil yielding excellent pasture from the valley of the Avon, near Salisbury, afforded one-eleventh of coarse siliceous sand; and the finely-divided matter consisted of

7.	Alumina.
14	Silica.
63	Carbonate of lime.
2	Oxyd of iron.
14	Vegetable, animal, and saline matter.

In all these instances the fertility seems to depend upon the state of division, and mixture of the earthy materials,

rials, and the vegetable and animal matter; and may be easily explained on the principles which I have endeavoured to elucidate in the preceding part of this Lecture.

In ascertaining the composition of sterile soils with a view to their improvement, any particular ingredient which is the cause of their unproductiveness, should be particularly attended to; if possible, they should be compared with fertile soils in the same neighbourhood, and in similar situations, as the difference of the composition may, in many cases, indicate the most proper methods of improvement. If on washing a sterile soil it is found to contain the salts of iron, or any acid matter, it may be ameliorated by the application of quick lime. A soil of good apparent texture, from Lincolnshire, was put into my hands by Sir Joseph Banks as remarkable for sterility: on examining it, I found that it contained sulphate of iron; and I offered the obvious remedy of top-dressing with lime, which converts the sulphate into a manure. If there be an excess of calcareous matter in the soil, it may be improved by the application of sand, or clay. Soils too abundant in sand are benefited by the use of clay, or marle, or vegetable matter. A field belonging to Sir Robert Vaughan, at Nannau, Merionethshire, the soil of which was a light sand, was much burnt up in the summer of 1805; I recommended to that gentleman the application of peat as a top dressing. The experiment was attended with immediate good effects; and Sir Robert last year informed me, that the benefit was permanent. A deficiency of vegetable or animal matter must be supplied by manure. An excess of vegetable matter is to be removed by burning, or to be remedied by the application of earthy materials. The improvement of peats, or bogs, or marsh lands, must be preceded by draining; stagnant water being injurious to all the nutritive classes of plants. Soft black peats, when drained, are often made productive by the mere application of sand or clay as a top dressing. When peats are acid, or contain ferruginous salts, calcareous matter is absolutely necessary in bringing them into cultivation. When they abound in the branches and roots of trees, or when their surface entirely consists of living vegetables, the wood or the vegetables must either be carried off or be destroyed by burning. In the last case their ashes afford earthy ingredients, fitted to improve the texture of the peat.

The best natural soils are those of which the materials have been derived from different strata; which have been minutely divided by air and water, and are intimately blended together; and in improving soils artificially, the farmer cannot do better than imitate the processes of nature.

The materials necessary for the purpose are seldom far distant: coarse sand is often found immediately on chalk; and beds of sand and gravel are common below clay. The labour of improving the texture or constitution of the soil is repaid by a great permanent advantage; less manure is required, and its fertility insured: and capital laid out in this way secures for ever the productiveness, and consequently the value, of the land.

Description of a Machine for serving Ships' Ropes by one Person only.

By Mr. EDWIN JONES, *of Southampton.*

With an Engraving.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

Ten Guineas were voted to Mr. JONES *for this Communication.*

IT is necessary to observe, that in the common mode of serving ropes two persons are usually employed, one to hold and manage the ball of spun yarn, the other person to lay it with a machine, resembling a wooden mallet, with a groove in the head to work in the rope to be laid. By my plan I can save the expense of the man who usually manages the ball of yarn; and for this purpose I have attached a reel to the serving mallet, and the yarn for laying the rope being wound on the reel, and passing under a pulley, from thence between two others to the rope, and the reel and apparatus all turning round together, the rope is laid by one person managing the whole.

From being disappointed by a person who should have assisted me in laying ropes in the common way, I was led to invent this apparatus, and I have by this means served or laid forty-two yards of rope in one afternoon. I have served five-inch ropes in a similar manner. The yarn is wound upon the reel, by means of a handle, in less time than on balls, and the whole work is done as well, and with more expedition than in the common mode.

When I work with a large machine, I add a lead counterpoise, to balance the motion of the reel.

REFERENCE TO THE ENGRAVING.

Fig. 10, (Plate VIII.) is a representation of the machine in a working state. A is the box or case, which encloses the whole machine. B C are the uprights, which are connected to the ends of the box A, and supported by the diagonal braces. D E, one part of the rope, is made fast round the upright C, leaving out a length to be laid nearly equal to the distance between the uprights B C; to the upright B is attached an iron frame *c*, which has a hook *e*, that receives one end of the rope, and by means of the eye screw *b* the hook *e* is made to traverse in a lateral direction, by which the rope between the uprights B C is stretched.

Fig. 11 is the reel apparatus, which contains the line, twine, or cord, that is to serve or cover the rope F; the reel *f* revolves upon two pivots, and the line upon it passes through the guide-pulley *i*, and between the rollers or pullies at *k*, and by means of the handle of the reel apparatus it is thrown in a spiral or screw direction along the whole length of the rope till the rope is completely covered or served. The reel apparatus or frame is confined upon the rope by two standards *h*, that encompass the rope, and according to the diameter of the rope is the pin passed through that set of holes in the standards that are best adapted to its size.

This machine is simple, efficient, and portable, and will be found to be superior to any machine used for that purpose in the particulars specified.

Description of a Method of securing Ships' Guns and Carriages. By Mr. ALEXANDER LAW, *of Deal.*

With an Engraving.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Silver Medal was voted to Mr. LAW *for this Communication.*

I BEG leave to lay before the Society a model of a method of securing ships' guns and carriages, by means of my right and left handed screw, lever, and hook nuts. This invention will enable one man to perform the duty of seven, and in one-third part of the time secure the gun for sea service. It possesses the advantage of great safety where new breechings are used, which require to be tightened or re-secured at sea, in the event of being taken by a gale of wind. In such a case one man can with ease tighten and secure all the guns on the lower deck without danger, by taking one or two turns with the lever of the screws; whereas in the common span lashing you must take all but two turns off before you can again span the breeching in; and, in general, when the lower deck guns are in want of fresh securing, all the men quartered at those guns are necessary at that time; and, it is further evident, that a single man to each gun, with my apparatus, will re-secure them in less time than all the men that are quartered on the present system.

Certificates in favour of Mr. Law's method of securing ships' guns and carriages were received from the following Naval Officers, *viz.* Admiral Foley, Captains Boys, Downman, Wilkinson, Ganely, and Wemyss, Lieutenants Welstead, Boyle, and Cree.

Reference to the Engraving.

Figs. 12 and 13 (Plate VIII.) represent Mr. Law's plan of lashing gun carriages, &c. by means of an apparatus, with a right and left handed screw. A, the lever; B B, the left handed screw; C C, the right handed screw; D D D D, hooks for laying hold of the ropes. The act of turning the screws by the lever A, one way, extends the hooks from the ball or head of the screws, and slackens the ropes; and, by turning them the contrary way, the hooks move towards the head or fall of the screws, and thereby render the ropes tight.

On Mosaic or Tesselated Pavements. By M. Roedlich.

From the Annales des Arts, &c.

Mosaic work has been known from time immemorial, and, like all other arts, has suffered many changes: though instead of improving, it has retrograded, if not in the method of composing it, at least in the execution.

The very tedious labour that is required to construct a Mosaic pavement, after the manner of the ancient, and probably too the different arts since invented to supply its place, have been the causes of its decline. In the time of Augustus the Mosaic was made with small pieces of square glass, manufactured for the purpose of all colours, and arranged upon a base of stucco, so as to form pictures of all descriptions. The effect of these pictures was similar to that produced by tapestry, and the mode of shading was absolutely the same. Afterwards small square pieces of marble were substituted for the small squares of glass. Arabesque ornaments were represented on pavements of large dimensions, and on the smaller landscapes and figures of men and animals. The walls of apartments were even decorated with this work; and this part of the art bore the name of Marquetry in stone. To form the paste or stucco in which the squares of marble were incrusted, they made a mixture of one part of slacked lime and three parts of marble of the Tibur, pounded, which they moistened with linseed oil.

The species of Mosaic pavement that M. Roedlich calls Venetian pavement requires less art and less time than the ancient Mosaic. But it is neither so brilliant nor so perfect, although it appears that it has nevertheless a very agreeable effect.

M. Roedlich has described the processes used in this art, and the instruments employed, with much care and clearness; we shall limit ourselves to give a general idea of the processes, in order that they may be compared with the ancient practice.

This pavement is constructed upon arches; the principal care is, that the ground be very even and dry. A first bed is formed of old plaster, of about two inches thick; the second is composed of the same materials, mixed with pounded brick, lime, and sand; this bed is three inches thick; the third bed is formed of two parts of pounded brick and one of lime; it is nearly two inches thick, it is moistened with lime-water, that it may unite with the other beds, and render the surface smooth, and perfectly level. This is called the red bed. A fourth bed is made with white marble, pounded and passed through a sieve, mixed with one-third of quick lime; this bed is half an inch thick; it is treated like the preceding, in order to unite it, as well as possible. When the whole is dry the workman traces on the ground the design of the picture, and the places which the pieces of different coloured marbles are to occupy, and which are simply broken with the point of a hammer. These pieces are laid on flat, according as their colour agrees with the design, with care to leave a space between each. These pieces of marble form the principal colour of the pavement; the spaces between are filled with broken marble, of different colours. The rest of the operation consists in beating the mass carefully, to render it firm, and in rolling over it, from one end to the other, and in every direction, a hard stone cylinder, in order to make it smooth and polished.

The cracks or fissures that come in the drying are filled up with the substance that composed the fourth bed; the pavement is rubbed with bran, the outlines of the pieces of marble are drawn with black chalk, and where it is necessary a light coat of water-colour is laid upon it, of which M. Roedlich describes the preparation.

Lastly, the whole surface of the pavement is rubbed with a piece of woollen stuff, moistened with linseed oil*.

A new Method of obtaining pure Muriatic Acid with Facility and Economy. By M. BRUGNATELLI.

From the GIORNALE DI FISICA DE BRUGNATELLI.

THIS apparatus is composed of three pieces; 1st. a matras, which may be either tubulated or not; 2d. of a bent tube, which is the principal piece, and, 3d. of an ordinary glass bottle, which should in preference be straight and high, in order that the mouth may be closed with a ground-glass stopper.

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* An invention superior to this, and for the same object, is included in the Patent granted to J. F. Wyatt, and published in Vol. XXVII. of the Repertory of Arts, and manufactured by C. Carter, Dean-street, Soho.

Into the matras, which is placed upon a sand-bath, is put eight ounces of pure common salt, reduced to a coarse powder. Into the bent tube is introduced a solution of muriate of barytes, which rises to equal heights in the two branches that form the curve; upon the salt is poured five ounces of sulphuric acid; the bent tube is then immediately adapted to the neck of the matras, fixed in a cork stopper, in which is also a capillary tube, communicating with the matras, if the matras be not tubulated, and which is fastened in with a little soft wax.

When the white vapour begins to appear in the other extremity of the bent tube, the glass bottle is directly added, containing a quantity of distilled water, corresponding in weight with the common salt employed, but not exceeding in bulk more than half the capacity of the bottle. The mouth is slightly stopped with a cork, which crosses the long branch of the bent tube.

As soon as the muriatic gas begins to develope itself, it continues without interruption even at the ordinary temperature and pressure of the atmosphere. The apparatus is slightly heated as the operation advances, in order to facilitate and hasten the disengagement of the gas. The solution of muriate of barytes put into the bend of the tube rises during the passage of the gas into the ball, which it partly fills, so that all the acid gas necessarily passes through it, and is washed in it, before it arrives at the water in the bottle.

We observe, in the course of the operation, that the solution of barytic salt, placed in the bent tube, becomes decomposed and turbid, acquiring at the same time a dirty yellow hue. The acid gas that passes into the bottle is in such great quantity, that the water in the lower part of the tube becomes sometimes considerably heated. For this reason the author found it necessary to plunge the bottle into a larger recipient, containing cold water, or, in preference, water mixed with snow. At the end of the operation, when it is seen that the *hydrate of muriatic acid* (muriatic acid gas combined with water) in the bottle begins to rise above the tube, the capillary tube of the matras is opened, and the apparatus suffered to cool. The bent tube is afterwards taken away, and the bottle containing the liquid muriatic acid is immediately stopped.

Water distilled at a mean atmospheric temperature and pressure condenses about four hundred and fifty times its bulk of oxymuriatic gas, and augments to about one-third of its primitive bulk.

The liquid muriatic acid obtained by this apparatus is found to be very strong, smoking transparent, of a yellowish colour, and entirely deprived of muriatic acid. When a tubulated matras is not to be had, we may adapt, as before mentioned, the capillary tube in the stopper, which closes the untubulated matras. In some cases a retort may be employed. The operation becoming very easy, it will be best to operate upon a small quantity of salt, and repeat it several times if necessary, and then the matras and the retorts may be of a middling size, and be used several times for the same operation.

Report

Report of M. de LASTEYRIE *on the Specimens of Pitch and Tar manufactured in France, after the Process of M.* BADEIGTS LABORDE.

(Concluded from Page 191.)

WE have said, that if the management of the tar kiln be well conducted it must necessarily yield tar of the first quality. But there are many accidents likely to take place. As the degree of heat required, and the evaporation of the aqueous part can only be conjectured, a moment's neglect or inattention may produce the most serious consequences. If, for instance, too large a quantity of the matter is suffered to accumulate upon the floor, the fire easily reaches it, inflames and consumes a great part, leaving only a burnt residuum, deprived of all the unctuous part, which constitutes its perfection. If any rain fall while the fire is alight, it does considerable damage, more or less, according to the time when it comes on, and the quantity that falls, for then the tar obtained is charged with moisture. These defects are quite sufficient to throw discredit on the tar of France, and to encourage the introduction of Northern produce.

One principal cause of the introduction into commerce of French pitch and tar of inferior quality is the bad construction of the establishments where the different products of the pine are manufactured. The tar kilns are generally merely holes made in the sand, rudely coated inside by a light bed of clay: the recipient or trough is also only an imperfect ditch, lined with planks of pine, always badly joined together. The hole in the kiln, by which the matter escapes, is stopped with a stone, to prevent the bits of charcoal from passing through. In short, the whole apparatus

paratus is entirely exposed to the attacks of the weather when not in use. The tar when it is finished is mixed with water, sand, charcoal, and other different substances, which entirely deteriorate its quality.

2. *On the Method of purifying the French Tar.*

The good reputation of the Swedish tar proceeds from its possessing three principal qualities, a proper degree of fluidity, a perfect amalgamation of all the parts, and a fine yellow gold colour, which is a certain indication that the substance has received a proper degree of heat. The tar from les Landes, on the contrary, is more or less thick, but always more so than is proper; no continuity, or fusion of the constituent parts, and of a deep bottle-green colour, which is a proof that it has not received a proper degree of heat. The eye with very little practice may judge of these facts; it is only necessary to put a portion of each into a white glass vessel; by inclining the vessel that contains the tar of les Landes, and then putting it upright again, the tar will leave on the sides an innumerable quantity of little lumps, as sour milk would. These are little portions of resin which the fire has not sufficiently melted. Nothing like this is to be seen in the Swedish tar. The intention in the use of tar being to preserve wood and cordage from damp and from the influence of the atmosphere, we may conclude that it can only be looked upon as a sort of low priced paint; it must therefore possess as great a portion as possible of those qualities that distinguish the best, such as is used for wainscotting. A paint that is too thick, and consequently cannot be spread uniformly, is of course rejected, or if the least portion of water be mixed with it. The tar of les Landes always contains a greater or less quantity of water; that of Sweden is always free from it.

Tar when too thick cannot be uniformly spread in careening, for the part that has not received sufficient heat will form little protuberances on the surface of the wood, and when the air has absorbed the little essential oil that it contains, it leaves it quite friable, without tenacity, and it falls into a powder with the least friction, and the place it was intended to defend is left exposed.

The inconvenience is much more considerable when it is applied to cordage, for then the bits of hemp that compose the rope, being glued together with tar that contains scarcely any essential oil, lose their elasticity, and break when folded in the various directions to which they are necessarily subject. This is what is vulgarly called burnt cordage. It has been thought that this inconvenience could be remedied by heating the tar, without reflecting that this thick tar, though rendered liquid by the action of the fire, cannot acquire any quality by this fusion, and when cold again retains its former defects. Yet if this operation be carefully performed, it may, though imperfectly, attain the desired end; but the direction of the fire is always left to a child; being encreased without precaution, and, as we may say, by jerks, the tar is raised to ebullition before the desired change is completed, and a great part of the essential oil, of which it already contained an insufficient quantity, evaporates and thickens also. When cold it covers the cordage with a black and stiff crust, which soon falls into a powder.

Hitherto no other means has been found of extracting the water from tar than piercing the casks that contain it with a small borer, and introducing into this hole some whisps of straw, which serves to keep the tar in without stopping up the hole hermetically, so that the water escapes drop by drop. It is easy to suppose that this is a very insufficient and imperfect method, for none of the water that is above the hole, and especially what is below it, can run out; and it is well known, that a single glass of water is sufficient to render useless several quintals of tar.

Struck with these inconveniences, M. Laborde sought to rectify the French tar by allowing it to be sufficiently baked, by evaporating all the water, by giving it a suitable degree of fluidity, by restoring to it the essential oil that it wants, and especially by carefully freeing it from all heterogeneous particles.

Agreeing in opinion with all navigators, that cordage is spoiled by the application of boiling tar, and persuaded that its strength is not weakened by the tar being applied cold, M. Laborde has invented an apparatus which yields him a sort of virgin tar, or essential oil of tar, capable of penetrating much more into the rope-yarn, and which, instead of forming a black and hard crust upon it, gives it the strength and elasticity that is required. Our indigenous pitch is altogether bad. It wants tenacity and unctuousness, or oiliness; so that when it is used, its durability, compared with that from the North, is nearly as one to a hundred. This proceeds from a bad mode of manufacture, which M. Laborde has no doubt of being able to cure.

All navigators agree that the indigenous pitch and tar suffer a waste of at least twenty *per cent.* which they cannot lessen, and this waste proceeds from the sand, charcoal, &c. which the cupidity or carelessness of the petty resin-makers either add to them or suffer to be introduced. M. Laborde's purified tar is subject to no loss, and he assures us, that when he has established his operation in the large way, he shall be able to simplify and improve his method.

On

On the Use of Sulphate of Soda in making Glass.

By M. GEHLIN.

From the JOURNAL DE SCHWEIGER.

M. GEHLIN, of whom chemistry has been deprived by a premature death, and who cultivated it with success, was much occupied with the manufacture of glass, in which he employed sulphate of soda as a flux. It is not the salt that is vitrified with the silex, but rather the soda which abandons the sulphuric acid at an elevated temperature, in consequence of the chemical action that soda and silex exercise upon each other. After a great number of trials, M. Gehlen found that the following proportions were the best.

100 sand, 50 dry sulphate of soda, from 17 to 20 of quick lime, in a dry powder, and 4 of charcoal.

This composition, without the addition of any other flux, always gives a very fine glass for goblets and wine glasses, and no sulphurous smell is remarked, which was sometimes so powerful as to incommode the workmen, nor the extraordinary crackling which is manifested in the pots when other proportions are employed. After numerous observations M. Gehlen announces the following results.

1. Sulphate of soda may be employed in the manufacture of glass, without the addition of any other saline flux. The glass resulting from it is as fine as any that is made with the usual materials, and possesses all the properties of glass made with soda.

2. Sulphate of soda vitrifies very imperfectly with silex alone, even when the heat is continued for a long time. By the intermedium of lime the vitrification succeeds

better, but not in proportion to the time and the fuel that must be employed.

3. On the contrary, the vitrification is effected in a short time, and in a perfect manner, by means of any substance which decomposes the sulphuric acid of the sulphate of soda, and thereby destroys the powerful affinity which prevents the soda from acting on the silex. It is charcoal which best attains this object: however, in the preparation of flint glass, metallic lead may be substituted in its place.

4. This decomposition of the sulphate of soda may be effected even during the vitrification, or before it. Local circumstances may determine in the choice of either one or other of these processes; but the latter presents no difficulty.

Caveat respecting sealed Specifications.

Court of Chancery, Thursday, July 25, 1816.

Ex-parte HEATHCOTE *in the Matter of* LACY.

MR. Bell stated, that this was an application to the Court, praying that his lordship would not put the great seal to a patent which Mr. Lacy, of Nottingham, had sought to obtain for making lace by a machine, to be worked by a steam-engine. The ground of objection to the patent was, that Mr. Lacy wanted to keep his specification secret for the space of fifteen months, which was contrary to the policy of the law, and a great injustice to the king's subjects in general.

On the part of Mr. Lacy, Sir Samuel Romilly and Mr. Hart urged, that no injustice would be done to the public by granting the patent, and the State would be benefited in, a peculiar way. Mr. Lacy had invented a machine for making French lace of the most beautiful texture; and if the benefit of his invention was secured to him, by enabling him to lodge the specification under certain restrictions, this country would be enabled to rival the French in the sale of that article in the continental markets. At present, the French, by having the materials and labour at a much cheaper rate, could afford to undersell us considerably in that very important branch of their manufactures; but if this patent were granted, the saving, with respect to labour, would be more than equal to the difference in price of the materials. This was the principal object for wishing to keep the specification secret: for there was reason to apprehend, that if the particular description of the invention should be enrolled within the usual period, copies thereof would be obtained by foreign agents, and transmitted to foreign countries, the inhabitants of which would have the benefit of making use of the invention before his Majesty's subjects could by law make use of the same; which would not only prevent the patentee from deriving the full advantage which he has reason to expect, but might also tend to diminish the benefit which the lace-manufactures of this country might otherwise derive therefrom. This was the ground upon which the Legislature had thought proper to grant an Act of Parliament (53 Geo. III. cap. 179) to Mr. Lee, for securing his invention of preparing hemp and flax. By a proviso in the letters patent, which were granted for the term of fourteen years, that gentleman was allowed to keep his specification secret for fifteen months from the date thereof: and, with a view to secure the benefits of his invention to this country, the act directed, that instead of causing the particular description of the invention to be enrolled according to the said proviso,

viso, he should deliver to the Lord Chancellor, within fifteen months from the date of the letters patent, a particular description or specification of the nature of his invention, and in what manner the same was to be performed, by writing under his hand and seal; which specification, together with an affidavit made before a Master in Chancery, that it fully, completely, and accurately defined and described the whole and every part of such invention and discovery, and the method of using and employing the same for the uses and purposes therein set forth, should be enclosed in a cover under the seal of the Lord Chancellor, and lodged in the office of one of the Masters in Chancery, to be nominated successively, from time to time, as occasion might require. The second clause of the act declared, that the said packet should not be removed from the custody of the Master in Chancery on any account or pretence whatever, except by order of the Lord Chancellor, who should have power to call for and have the same whenever there should be occasion to have recourse thereto, either on account of application being made for patents for other discoveries or inventions, which there might be reason to apprehend might be of a nature similar to the said invention, or on account of any trial at law respecting the same, or in any other case in which it might be judged by the Lord Chancellor necessary or proper to inspect the same; in all which cases the seal of the said packet might be broken by the Lord Chancellor; and after such use should have been made of the said specification, as occasion should require, the same should be again sealed up, and deposited with a Master in Chancery, as before directed. And by the fifth clause it was enacted, that the said packet, so to be deposited, should be kept and remain sealed and unopened (except as aforesaid) until the expiration of the term of seven years from the passing of the act, at which time the specification should be enrolled in manner directed by the proviso contained in the letters patent, there to be and remain public for the benefit of all his Majesty's subjects. These were the particular privileges which the Legislature had given to Mr. Lee, for the purpose of securing the benefits of his invention to this country; and as Mr. Lacy had made an affidavit that he intended to apply for a similar Act of Parliament, the learned Counsel hoped that his Lordship would not withhold the great seal from the patent.

The Lord Chancellor said, that he could not put the great seal to a patent which gave the party fifteen months to make out his specification. In the present reign about 20,000 patents had been granted, and this indulgence was extended only in two or three of them. Where the letters patent were for an invention to be used in England, Scotland, and Ireland, the usual period for invoking the specification was six months; but where they were confined to England only, three or four months was the given time. Mr. Lee's case was a very peculiar one: it was for securing to the State, in a time of war, the benefit of a most important discovery. If Mr. Lacy could make out that the State was to be benefited by his invention in any peculiar way, as in the case of preparing hemp and flax, it might be doubtful whether he might not have a secret specification. His lordship was of opinion, however, that the Legislature would pause a long time before they passed such an act in future; and he thought he might venture to say, that if Mr. Lacy were to apply for such an act he would not procure it. The gentlemen had said, that if this specification was not kept secret the French might copy it; but his Lordship could not establish a new principle merely to prevent the

French from smuggling; neither could he put the great seal to a patent without seeing the specification, for it might turn out not to be worth a farthing, and then public genius would be discouraged merely for the benefit of the patentee. Many cases of this nature had occurred. The patent could not pass without the responsibility of the great seal; and if his Lordship could bring himself to pass it, he might be called upon to give an account in Parliament why he had extended this particular privilege to this individual. It was certainly contrary to the general policy of the law, and he could not in justice to the King's subjects affix the great seal to it merely because it was a manufacture which other countries had in common with this.

List of Patents for Inventions, &c.

(Continued from Page 192.)

HENRY WARBURTON, of Lower Cadogan-place, Chelsea, Middlesex, Esq.; for a method of distilling certain animal, vegetable, and mineral substances, and of manufacturing certain of the products thereof. Communicated to him by a certain foreigner residing abroad. Dated July 27, 1816.

ROBERT SALMON, of Wooburn, Bedfordshire, Surveyor; for further improvements in the construction of Machines for making hay. Dated July 27, 1816.

JOHN HAGUE, of Great Pearl-street, Spitalfields, Middlesex; for improvements in the method of expelling the molasses or syrup from sugars. Dated July 27, 1816.

WILLIAM HENRY, of Manchester, Lancashire, Doctor of Physic; for improvements in the manufacture of sulphate of magnesia, commonly called Epsom salts. Dated August 3, 1816.

John Poole, of Sheffield, Yorkshire, Victualler; for brass and copper plating, or plating iron or steel with brass or copper, both plain and ornamental, and working the same into plates, bars, or other articles. Dated August 3, 1816.

John Chalklen, of Tower-street, Seven Dials, Middlesex; for improvements in or on valve-water-closets. Dated August 3, 1816.

John Welch, of Preston, Lancashire, Cotton-mill-roller-maker; for an improvement in the manner of making rollers used in spinning of wool, cotton, silk, flax, tow, or any other fibrous substances. Dated Aug. 3, 1816.

John Dayman, of Tiverton, in the county of Devon, Gentleman; for a method of covering or coating iron, steel, and other metals, or mixtures of metals, with tin, lead, copper, brass, or other metals, or mixtures of metals. Dated August 3, 1816.

Samuel Nock, of Fleet-street, London, Gun-maker; for an improvement in the pan of locks of guns and fire-arms. Dated August 12, 1816.

Edward Biggs, of Birmingham, Warwickshire, Brass-founder; for improvements in or on the machinery used in the making or manufacturing of pans and *stails* of various kinds. Dated August 14, 1816.

Robert Tripp, of Bristol, Woollen-draper; for an hussar garter with elastic springs and fastenings, and also elastic springs for pantaloons and other articles. Dated August 14, 1816.

William Moult, of Bedford-square, Middlesex; for improvements on his former patent for an improved method of acting upon machinery, bearing date the 23d day of May 1814. Dated August 14, 1816.

James Neville, of Wellington-street, Northampton-square, Middlesex, Gentleman: for new and improved methods of generating and creating or applying power, by means of steam or other fluids, elastic or non-elastic, for driving or working all kinds of machinery, (including the steam-engines now in use,) and which are applicable also to the condensing of steam and other aqueous vapours in distillation or evaporation, and are useful in various manufactories and operations where heat is employed as an agent, or where the saving of fuel is desirable. Dated August 14, 1816.

Jean Samuel Pauly, of Brompton, Middlesex, Engineer; for a machine for ascertaining, in an improved manner, the weight of any article. Dated August 15, 1816.

Anthony Gilchrist, of Worship-square, Middlesex, Gentleman; for a machine for making of nails, screws, and the working all metallic substances. Dated August 15, 1816.

Robert Salmon, of Wooburn, Bedfordshire, Surveyor; for improved instruments for complaints in the uretha and bladder. Dated August 19, 1816.

ERRATUM.

In our last Number, Page 131, line 19, the word *call* is omitted after the word *shall.*

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. CLXXIII. SECOND SERIES. Oct. 1816.

Specification of the Patent granted to JOHN KILBY, *of the City of York, Brewer; for an Improvement or Improvements in the Art of brewing Malt Liquors.*

Dated June 1, 1816.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said John Kilby do hereby declare, that the nature of my said invention, and the manner in which the same is to be performed, are described as follows; that is to say: In the common way of boiling the wort there is frequently, if not always, produced, by the action of the fire upon the brewing copper or vessel, a greater or less degree of burning of the extract; and this I prevent by never suffering either fire or flame to come in contact with the vessel in which the wort is boiled, but effecting the boiling of the wort by means of steam applied to the outside of the vessel in which the wort is contained. For this purpose I inclose my brewing vessel in another vessel, which I call the case or jacket, made either of metal or of wood, in such a manner that a convenient space may be left between the said case or jacket and brewing vessel for the admission of steam from a boiler, with fire under it, by means of a tube or tubes, or any convenient communication by which steam may pass from the said last-mentioned boiler into the said space between the case or jacket and the brewing vessel.

In arranging this simple apparatus, the following particulars should be attended to.

First. The brewing vessel must be so well secured in its case or jacket that there may be no way for the steam admitted between them to escape but through a valve (or valves) or cock (or cocks) provided for the purpose; but I prefer the valve, because, by means of the load or weight put thereon, the escape or detention of the steam is very easily regulated.

Second. The brewing vessel should rise somewhat higher than the case or jacket, or, in other words, it is advisable not to apply the steam to the brewing vessel higher than the worts within it rise to; and, to prevent this, it is safer to have the brewing vessel filled to such an height that the evaporation by boiling the worts may never bring the surface quite so low in the vessel as the part on which the steam acts. The reason for this precaution is this: some portions of the hop are apt to apply themselves to the side of the vessel above the worts, where they remain longer or shorter, according as accident may direct; and such portions, by being exposed to a greater heat than that of the worts, might possibly be injured in their flavour, and, if so, when again carried into the worts by any swell of the boiling, might affect the flavour of the beer.

Third. The boiler that supplies the steam should also be furnished with a steam valve or valves.

Fourth. The boiler should be placed somewhat lower than the brewing vessel, in order that the water produced by the condensation of the steam in the case or jacket, while the brewing vessel and its contents are having their temperature raised to the boiling point, may be returned to the boiler by means of a tube.

Fifth. The tube or tubes which connect the boiler and the case or jacket should be furnished with a cock or cocks, or valve or valves, to enable the brewer to shut off or admit the steam at pleasure.

The advantages resulting from this improved method of brewing are, the preventing entirely the possibility of any burning or setting too of the extract to the bottom of the brewing vessel, the degree of heat applied thereto being so perfectly under controul, by means of the safety valve (or valves), that it can never exceed the degree wanted.

N. B. For dispatch, it may sometimes be convenient that the safety valve should be so loaded, that the temperature of the steam may be raised from ten to twenty degrees above 212°, that it may the more easily communicate to the brewing vessel the temperature necessary to bring its contents to the boiling point. And it is proper to remark here, that by employing a close brewing vessel with a safety valve, the temperature of the worts also may be raised above the common boiling temperature of 212°, and a larger portion of extract be thus obtained from the hop than by the common boiling temperature. As the extract of the malt is preserved from being hurt by the fire, so the hop is also preserved from injury, which makes it give out a greater quantity of extract and a finer flavour. The flavour of the beer thus brewed is superior to that boiled in the common way: and when properly fermented is more vinous, and spirituous, and palatable, Having thus described my said improvement or improvements in the art of brewing, it is only necessary farther to remark, that I do not rest my invention on the apparatus, as such, or claim the apparatus as my invention, but only its application to the art of brewing malt liquors. In other words, my invention consists in performing, by means of steam applied to the brewing vessel, what has hitherto been done by fire, applied directly thereto. In witness whereof, &c.

Specification of the Patent granted to JONATHAN RIDGWAY, *of Walworth Common, Plumber; for a new Method of pumping Water or other Fluids.*

Dated May 26, 1815.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Jonathan Ridgway, do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained in manner following; that is to say: The nature of my said invention, and the object of the same, is the production, such as is herein and thereby described, of a machine or apparatus for the working ships' pumps without the aid or intervention of animal labour; and applying to it, and using for its moving power, the pitching and rolling motions of the ship, or the so applying the said machine or apparatus to the ship or vessel that the pitching or rolling motion of the ship or vessel may become its moving power, or first mover; for which purpose I suspend a heavy body or weight, at the bottom end of a strong arm or lever, from a point above its centre of gravity, (in the usual way and manner of suspending pendulums,) in or upon a frame of sufficient strength to the centre of suspension of the weight so suspended; and in a direction at right angles with it I fix a beam or arm, which projects equally on each side the centre; and to each extremity of the said beam or arm is attached by a single bolt or pin, the upper end of the piston rod of a ship's pump; and the apparatus is set athwart the ship or vessel, that is to say, in such manner that the suspended weight might swing in the direction of the ship's breadth. The effect of this arrangement is, that at each roll or inclination of the ship or vessel the suspended weight will always retain, or endeavour to retain, its natural perpendicular position. The beam or arm which is attached to its upper end also retains its natural level, or horizontal position; and the pump barrels being fixed to the ship, and the buckets or pistons easily moveable in them, the pumps are thus put in action with each roll of the ship. The aforesaid suspended weight, and its attached beam or arm, may be said to hold the piston rods and buckets of the pumps stationary in the pumps, while the rolling motion of the ship or vessel moves the pump barrels up and down on them, and so makes the pumps work themselves.

I farther declare, that the aforesaid frame can, by well-known means, be so constructed as to be slued or turned so as to work with the pitching motion of the vessel. It is necessary that the aforesaid weight should be so considerable as readily and constantly to be able, without assistance, to overcome the friction and resistance of the pumps and its own suspension.

I farther declare, that when required I connect my aforesaid suspended weight with a wheel and pinion, in such manner that each roll of the ship may produce more than one stroke of the pump; that is to say, the large wheel is placed upon the axis on which the weight is suspended;

pended; and upon distinct axes, that run parallel with the axis of the aforesaid suspended weight, are fastened pinions, that work in the afore-mentioned wheel; and two projecting pins, placed near the outer edge of the aforesaid pinions, are connected to the piston rods of the pumps respectively, so that if one roll of the ship turns the pinion once round, two motions of the piston or pump bucket are produced.

I further declare, that in cases when the motion of the ship may not be sufficient to work the pumps, I reduce the aforesaid suspended weight, and work it to and fro, after the manner of a pendulum, by the application of manual labour. For this purpose the weight is made up, or composed, of any required number of pieces or separate weights, the required number of which may be detached and laid aside at pleasure.

I declare, that I set forth this use of the suspended weight in its reduced state to shew a useful application of it in a different way when it is so reduced, and not claiming such application of it for my patent. The aforesaid suspended weight, in its compleat state for producing the action of the pump by the roll of the ship as aforesaid, I make of about fifteen cwt. for pumps of six or seven inches bore, and for pumps of larger bore I increase the weight, taking generally for my scale of increase the rate of increase of the pumps barrels; this I judge to be sufficient when suspended at the distance of five or six feet from the point of suspension.

I do further declare, that as the construction of the frame, in or upon which the aforesaid weight may be suspended, will differ according to the position of the pumps and the construction of the vessel; and as it may in large ships be suspended to the beams of the deck, and consequently the length of the arm or lever at which the aforesaid weight is suspended may likewise differ; I claim only for my patent the application of a weight, (suspended in any convenient manner,) sufficiently ponderous, that with the rolling, pitching, or lurching motions of the ship or vessel, it will work the pumps without manual labour.

In witness whereof, &c.

Specification of the Patent granted to JOHN THOMAS DAWES, *of West Bromwich, in the County of Stafford, Iron-master; for certain Improvements in Steam-Engines, some of which Improvements are applicable to other Purposes.* Dated February 6, 1816.

With an Engraving.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said John Thomas Dawes do hereby declare, that my said invention is described and ascertained in manner following; that is to say: My improvements relate to two different parts of the steam-engine. First, an improvement to supersede or answer the purpose of that part which in common steam-engines is called the parallel motion, or parallel levers, and which are usually employed with a beam or lever working upon a centre. By means of my improvement hereinafter described, the alternately ascending and descending motion of the piston-rod in a right line, which I also call the reciprocating motion, is made to produce a continuous rotary or circular motion of the fly-wheel or main-shaft of the engine. Or, when this same improvement is applied to other purposes, such as working pumps, saws, or other machines, which depend upon an alternate rectilinear motion, my improvement will be employed for the reverse object, *viz.* to obtain such a reciprocating motion from the continuous rotary motion of a shaft, such as that of a water-wheel, or other first moving power.

Secondly, an improvement in the movement for alternately opening and shutting the valves which admit the steam into the cylinder, and allow it to pass away from the same to the condenser, or to the open air.

The principal parts of an engine to which my first improvement is applied are represented in Figs. 1 and 2, (Plate IX.) of the drawings hereunto annexed; upon which I shall observe, that the nature and construction of the steam-engine to which this improvement may be applied, need not be herein described, as it is no part of my invention, but that my means of producing the rotary motion from the rectilinear motion is applicable to any kind of steam-engine whatsoever which operates with a cylinder and reciprocating piston rod, with a view of producing a continuous circular motion, provided that the parts of the engine can be made so as to admit of the crank shaft, or that shaft to which the rotary motion is to be communicated being placed so as to intersect the line of the piston-rod, or centre line of the cylinder, when produced at right angles.

The engine represented in the drawing at Figs. 1 and 2 is of this description. A is the cylinder, *a* the piston-rod, B the fly-wheel, C its axis, supported in bearings D D, so that its centre line produced cuts the centre line of the cylinder at right angles. Upon the extremity of this shaft C, is fixed a crank S, the radius *d c* of which is equal to one-fourth of the stroke or excursion of the piston-rod; therefore the whole stroke of the crank, or the diameter of the circle which the pin *c* describes, is equal to half the stroke of the piston-rod. To the pin *c* of

Front View Fig. 1.

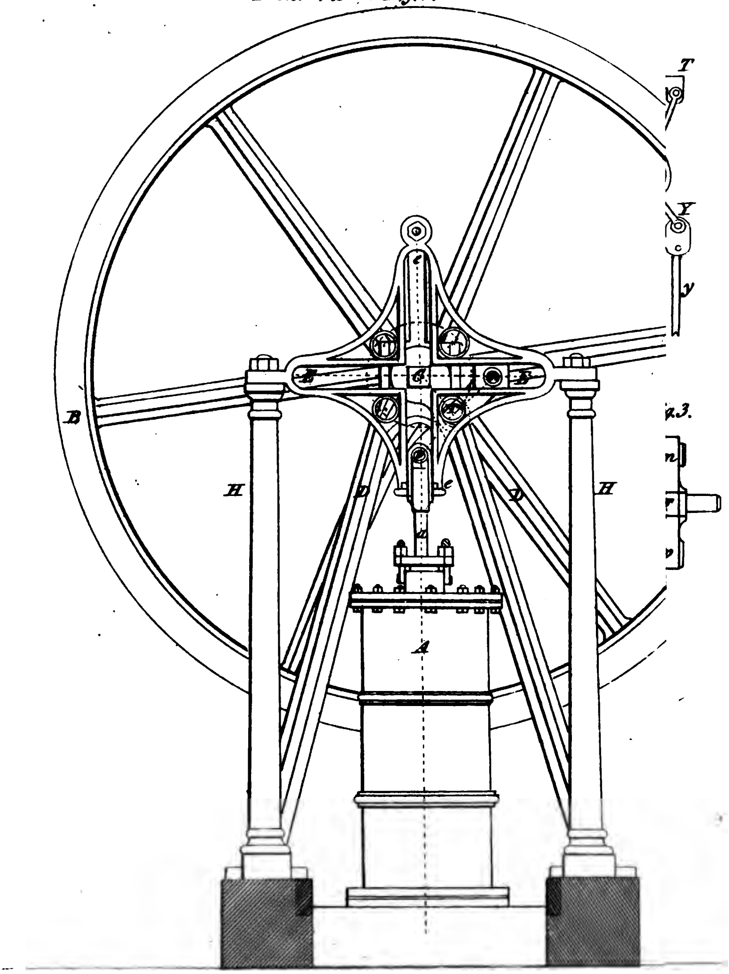
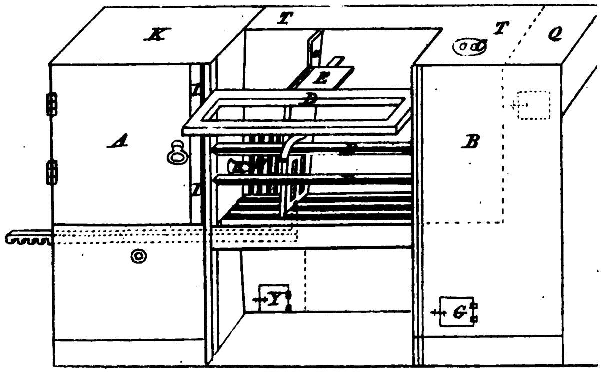


Fig. 7.



UNIV. OF MICH.

of the crank a bar F*mp*, which I call the connecting-bar, is jointed by the said pin *c* passing through the bar in the middle of its length, so that it can turn round freely upon the pin. The connecting bar has at each end a pin *m* and *p*, projecting perpendicularly outwards from it; which pins are exactly at equal distances from the centre F; and also both these distances F*m* and F*p* are exactly equal to the length or radius *dc* of the crank; the pin *p* passes through a slider or friction wheel, fitted into a vertical groove *e e*, which is formed in the fixed frame E E, *e e*, and by this means the pin is confined to move in a vertical direction, and no other; the pin *p* projects through the slider and groove E, and the upper end of the piston rod *a* is jointed to it. The frame E E, *e e*, is firmly fixed by columns, H, from the floor; or it may be fixed to the cylinder, or any other support. The pin *m*, at the opposite end of the connecting bar, passes through a slider or friction wheel, which traverses horizontally in a groove E E, formed in the same frame E E, *e e*, so that the pin *m* is retained to move backwards and forwards in a horizontal line E; which line is in the same plane with the line of the vertical groove *e e*, in which the pin *p* moves, and the said lines intersect each other at right angles; and also the centre line of the axis C of the crank (when produced) will pass through the same point of intersection, but in a direction perpendicular to the plane in which the other two links are situated. The consequence of this construction is to produce the continuous circular motion of the crank S from the alternate rectilinear motion of the piston-rod *a*, because, whilst the end thereof, and also the pin *p* of the connecting bar, are compelled to move in a vertical direction by the perpendicular groove *e e*, the end *m* of the connecting bar is compelled to move horizontally in the horizontal groove *e e*, and in consequence the centre point F of the said bar will in its motion describe a circle, and the crank pin c being attached to that point, will receive a circular motion therefrom.

The movement known by the name of sun and planet wheels may be applied to my first improvement, and will make the fly wheel axis revolve three times for one revolution of the crank; for this purpose a cog-wheel must be fixed upon the connecting bar at F, so as to turn round with it, and this is called the planet wheel, and is to give motion to another similar cog wheel, fixed fast upon the extremity of the axis of the fly-wheel, which axis must pass through a hollow or tube, which is the axis of the crank, and with which the crank revolves, but independently of the fly-wheel, the axis of which, as before mentioned, passes through the hollow or tube in the axis of the crank; and the aforesaid wheel, which is fixed on the end of the axis of the fly-wheel, is situated in the front of the crank; and this latter is the centre or sun wheel, which will be made to revolve three times for one ascent and descent of the piston-rod, provided the two wheels are of equal diameter. The air-pump of the engine may be worked by a rod T, jointed to the extremity of the pin *p*, and therefore the rod will have the same movement as the piston-rod. Or the cylinder of the steam-engine, to which my improvement is applied, may be inverted and suspended over the crank; then the piston-rod being prolonged, will serve to work the air-pump below. Or any other method of working the air-pump, and other necessary pumps, may be used.

My second improvement, *viz*, the machinery for working the valves, is shewn in Figs. 4, 5, and 6, and is also represented in Fig. 2, as being applied to the same engine as the first improvement; but it is equally applicable to any other form of steam-engine. In all these figures C represents the axis of the fly-wheel, and *r* a tooth or leaf, projecting from it in its revolution; this alternately actuates through double levers L P T and V X Y, each moveable upon fixed centre pins P and X, situate on opposite sides of the main shaft C. The levers are connected by the rods V T and L Y, in consequence of which any motion given to one lever will be communicated to the other in an opposite direction. To either of the double headed levers V X Y two rods *v y* are jointed on opposite ends V Y, and conducted to the valves, one rod being connected with that pair of valves which causes the piston to ascend when they are opened, and the other rod is connected with that pair which causes the piston to descend when they are opened. The manner of making the connection will vary in almost every different instance; but in the engine represented at Fig. 2, in the drawing, it is evident from inspection, the action of this mechanism is by the tooth *r* striking the arms *x* or *t* of the levers, as the axis C revolves in the direction of the arrow; when it strikes the arm *t* of the upper lever it passes, and leaves the two in the position of Fig. 4, but when the shaft C has made half a revolution, the tooth *r* meets the lower lever *x*, as represented in Fig. 6, and moves then into the position of Fig. 5, and so on alterternately to change the valves at every stroke.

I make no claim to any particular form or arrangement of the valves, my invention being confined to the manner of giving motion to them, as above described, and by means of which they are caused to open and shut suddenly, and at the moment when the piston is at the top or bottom of its stroke, and therefore nearly motionless.

In witness whereof, &c.

Specification of the Patent granted to JOHN BARLOW, *of Sheffield, in the County of York, Founder; for a new and improved Cooking Apparatus.*

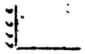
Dated July 2, 1816.

With an Engraving.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said John Barlow do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, are described and ascertained by the drawings in the margin of these presents, and by the following explanation; that is to say:

Fig. 7 (Plate IX.) represents a front view of my cooking apparatus, uniting an oven and boiler to a kitchen range, with contracting fire-place, so constructed that they will perform all the common operations of oven and boiler, with a very small quantity of fuel. A the oven door. B the front of boiler side. C aperture for filling the boiler. D D D the bars of the range, with or without a falling one. E a falling trevit or lip, which, when not in use, is turned up, and is fastened to, and forms a part of the moving cheek F, which is moved by the usual means of a rack and pinion, generally placing them immediately under the oven, and connecting the rack and cheek through the bottom grate, as is usual where the movement is placed below the grate. G the small door for cleansing the flue.

In the construction of this apparatus I use a cast iron oven, such as is well known by the name of Poker Oven. One of its sides forms one side or end of the fire-place, on which is cast a projecting piece or poker H, of a length and thickness proportioned to the size of the oven.

For ovens of midling size this poker will generally project from three to four inches, and be about one inch and a half in diameter, and made strongest or thickest at its root. In the inside of this oven, and at a small distance, say about half an inch from the side next the fire, I place a plate of cast or wrought iron, or other proper substance, in which I make a number of perforations. This plate forms, by means of two small ledges or stripes, a groove or space between itself and the oven side for the sliding part of a slit rack to move in, and the front edge of it may be returned, or otherwise formed, to cover the space or cavity made, as seen at I I. It also serves to break or correct the too sharp or scorching heat of that side of the oven, and to give a current of heated air through the oven by means of perforations in the returned part I I, and a valve stop cock or ventilator placed at the opposite side or corner of the top of the oven. The groove, or space, or cavity, for the sliding part of the rack on the boiler side, I place immediately below the bottom of the boiler, and join the sliding and rack parts at right angles thus  making the rack parts of equal lengths for the sake of uniformity. But though I here describe one mode of fixing spit racks (when required), which appears most suited to the construction of this apparatus, I do not confine myself to it, but use any of the methods commonly practised, of which the apparatus is capable.

To prevent the action of cold air on the top of the oven a plate or cap of cast or wrought iron, or other proper substance, may be placed on it.

When the oven is required to be made of great depth backwards, I cast an extra projecting piece, or poker, near the back part of the oven, on the same side as the other, so that when fixed and in use it projects into the flue at a small distance behind the grate at L, Fig. 8.

I ventilate the oven in any of the usual ways.

Fig. 8 is a perspective view of the boiler before it is fixed to the range, which forms one side or end, and the back part of the fire-place. At L is an opening, which is the commencement of the flue.

Fig. 9 represents a back view of said boiler. The arrow shews the course of the flue, which being brought through the corner at M, is conducted horizontally on the whole length of the boiler to N, and is then turned up the chimney in the common way.

Fig. 10 shews the end view of the boiler farthest from the oven, with a section of the flue when turned upwards. The part O is to facilitate the cleaning of it, at the small door G, Fig. 7. The cleaning is performed with a brush in common use, made in the manner of a bottle brush, but longer, and with joints in it. When the front part of the boiler P, Fig. 8, is very wide, to contain a greater body of water, in order to accelerate the boiling of it, I form a section of the flue in the back part of the boiler, by which means a greater surface of water is exposed to the action of the fire; but if the front part P is not required to be large, and uniformity of appearance is desired, I make or convert that part of the boiler cover Q, Fig. 7, which is unoccupied by the boiler, into a small hot plate, ironing or stewing stove, to be heated either by the boiler flue or by a separate fire in the usual way. I prefer the latter mode.

I use any material in the manufacture of my apparatus that is suitable for the purpose, and though I usually make the flue of iron, it may be made in brick-work to answer the purpose. I place a damper in any part of the flue most convenient, between the top of the boiler R and S, Fig. 10.

I make the range or bars in the common way, only the cheeks or standards reach to the ground to form the necessary fastenings for the fronts by screws, rivets, or otherwise. The bottom grate is supported by two cheeks, frames, or back legs. The boiler cover T T, Fig. 7, is fitted so as to be steam-tight, as is likewise the small lid at C, if the apparatus be wanted to produce steam. I make the boiler with or without a cock, with a feeding cistern or without, and, if necessary, adapt it for warming baths, or apartments, or cooking by steam. I generally approve of using a loose back, or stout plate of cast iron, or other proper material, which is placed against and covers that part of the boiler where the fire is kept in the range V, Fig. 8; and at the entrance of the flue L, Fig. 8, I place a grate W, Fig. 7, which, from its sloping position, and by means of a rebate on its edge next the boiler, retains its place; it therefore can easily be removed for cleansing the flue or renewal when injured. But as the ashes and small cinders will fall through this grate into the flue, I make an ash-pit, as represented at X, Fig. 9, immediately behind the grate W, Fig. 7; and, to prevent a current of air passing through this into the flue, I place a damper or small door in it Y, Fig. 7.

It may be observed, that although separate parts of this apparatus have been in use before, yet the arrangement and combinations are new, and produce considerable advantages, not possessed by any other cooking apparatus.

In witness whereof, &c.

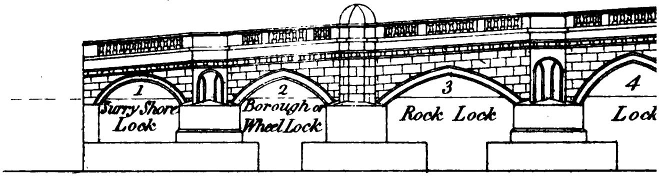
Alteration of London Bridge.

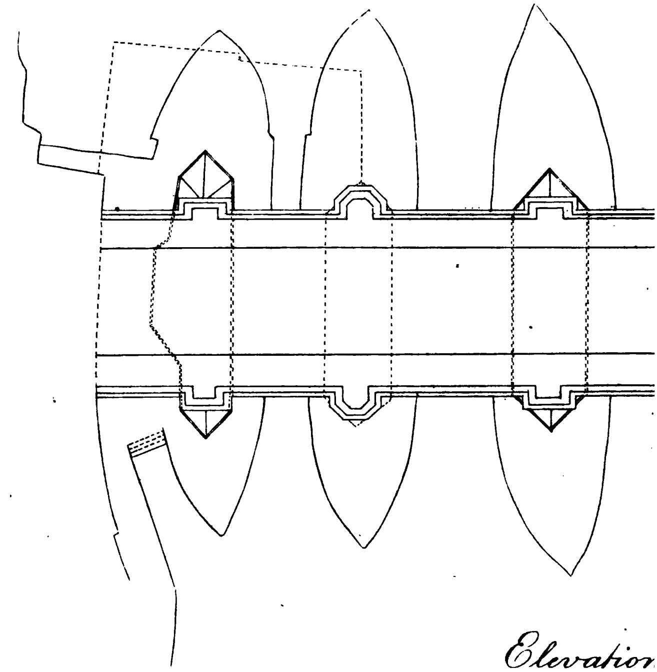
With a Plate.

HAVING given in our former Numbers the Report of the Engineers appointed by the Corporation of London, to consider what alterations could be made in the construction of London Bridge, so as to render the navigation through it safe and commodious, we have now the pleasure of presenting the public with an engraving of the design for the bridge, as proposed to be altered agreeably to that Report; by which it appears, that as much elegance and convenience is combined in that design as could well be expected in the alteration of such an incongruous structure. We understand, however, that the Corporation have determined to suspend the commencement of the proposed alterations until the SOUTHWARK BRIDGE be opened, in consequence of the following Resolution of the BRIDGE HOUSE COMMITTEE, to whom the Report above mentioned was referred, and by them to a Select Committee.

" That although the enlargement and improvement of " the water-way under London Bridge, in the manner " recommended by Mr. Dance and others in their Re" port, might remedy and prevent in a great degree the " inconveniences and losses occasioned by the present " contracted water-way, yet that the large sums of mo" ney to be expended and advanced before the works ne" cessary for that purpose can be commenced, added to " the very great expense attending the enlargement of " four arches, as recommended by them, would so far " exceed the advantages to be derived therefrom, that " the Select Committee, without expressing any opinion " on the question suggested in the said Report: ' *Whether*

" *it*





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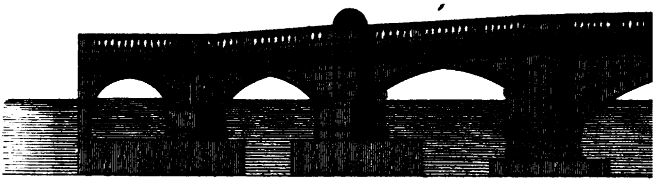

"*it will be more eligible to carry the proposed works into*
"*execution or to construct a new Bridge,*' were of opinion,
"*That it was not expedient that the enlargement and improve-*
"*ment of the water-way should be now proceeded with; and*
"*that the further consideration thereof should at all events*
"*be postponed until the Bridge now erecting from Queen-*
"*street to Southwark, to be called the* SOUTHWARK
"BRIDGE, *shall be completed.*"

With this Resolution the Bridge House Committe concurred.

Thus the Publick will suffer little or no inconvenience while these works are proceeding, as the Southwark Bridge will form a most convenient substitute for London Bridge to all the land traffic; the inconveniences of the water traffic must necessarily be endured a little longer.

We find from the Report of the Committee to which we have before alluded, that the Managers of the Waterworks have suggested, that a sum not less than 125,000*l.* would be required to purchase their leases, interest, and stock; and that the further sum of 50,000*l.* would be required for the erection of steam-engines to raise the same quantity of water as is now raised by the wheels; making the sum of 175,000*l.* to be expended before the proposed alteration could be commenced. The arrangement of this matter may occasion some delay also to the commencement of the work: but surely no pecuniary consideration should be allowed to obstruct the removal of such a trap for the destruction of human lives as London Bridge is in its present state; for it has been proved, before Parliament, that between thirty and forty lives were annually lost in the vortex under the Bridge. If such a sum be necessary to remove the nuisance, and the City find it inconvenient or improper to divert so much from other just appropriations, why not raise it on the publick by a toll on the Bridge? A penny on each pedestrian would raise the sum in five years, supposing the same number to pass over it as at present: but allow half the number, then ten years. This, though an inconvenience, had better be endured, than one which exposes our fellow-creatures to destruction.

On the Fire-Damp of Coal Mines, and on Methods of lighting the Mines so as to prevent its Explosion.

By Sir HUMPHRY DAVY, *LL.D. F.R.S. V.P.R.I.*

From the PHILOSOPHICAL TRANSACTIONS of the ROYAL SOCIETY of LONDON.

THE accidents arising from the explosion of the fire-damp or inflammable gas of coal mines, mixed with atmospherical air, are annually becoming more frequent and more destructive in the collieries in the North of England.

A committee has been for some time formed at Sunderland for the benevolent purpose of investigating the causes of these accidents, and of searching for means of preventing them. In consequence of an invitation from the Rev. Dr. Gray, one of the most active members of this committee, I was induced to turn my attention to the subject. I went to the North of England, and visited some of the principal collieries in the neighbourhood of Newcastle, for the purpose of ascertaining the condition of the workings, and the state of their ventilation. I found the greatest desire to assist my enquiries in the gentlemen acquainted with the northern collieries, as well as in the inspectors or viewers of the mines; and I have particular obligations on this point to the Rev. Dr. Gray, Cuthbert Ellison, Esq. M. P. the Rev. John Hodgson, Mr. Buddle, and Mr. Dunn. Dr. Fenwick, Dr. Clanny, and Mr. Fenwick, likewise kindly offered me their assistance.

From the information which I collected on the spot, increased by the perusal of a report of Mr. Buddle on the state of the mines, I was convinced that, as far as ventilation was concerned, the resources of modern science had been fully employed; and that a mode of preventing accidents was only to be sought for, in a method of lighting the mines free from danger, and which, by indicating the state of the air in the part of the mine where inflammable air was disengaged, so as to render the atmosphere explosive, should oblige the miners to retire till the workings were properly cleared.

An account of an ingenious apparatus for burning a candle supplied with atmospherical air by a bellows through water, has been published in the Philosophical Transactions, by Dr. Clanny; but I believe this apparatus has not yet been used in any of the colleries.

The common means employed for lighting those parts of the mine where danger is apprehended from the fire-damp, is by a steel wheel, which, being made to revolve in contact with flint, affords a succession of sparks; but this apparatus always requires a person to work it; and, though much less liable to explode the fire-damp than a common candle, yet it is said to be not entirely free from danger.

Mr. Buddle having obligingly shown to me the degree of light required for working the collieries, I made several experiments, with the hope of producing such a degree of light, without active inflammation; I tried Kunckel's, Canton's, and Baldwin's phosphorus, and likewise the electrical light in close vessels, but without success; and even had these degrees of light been sufficient, the processes for obtaining them, I found, would be too complicated and difficult for the miners.

The fire-damp has been shown by Dr. Henry, in a very ingenious paper, published in the nineteenth volume of Nicholson's Journal, to be light carburetted hydrogen gas, and Dr. Thomson has made some experiments upon it; but the degree of its combustibility, as compared with that of other inflammable gases, has not, I believe, been examined, nor have many different specimens of it been analysed; and it appeared to me, that some minute chemical experiments on its properties ought to be the preliminary steps to enquiries respecting methods of preventing its explosion. I therefore procured various specimens of the fire-damp in its purest state, and made a number of experiments upon it. And in examining its relations to combustion I was so fortunate as to discover some properties belonging to it, which appear to lead to very simple methods of lighting the mines, without danger to the miners, and which, I hope, will supply the desideratum so long anxiously required by humanity. I shall in the following pages have the honour of describing these properties, and the methods founded upon them, to the Royal Society, and I shall conclude with some general observations.

The fire-damp is produced in small quantities in coal-mines, during the common process of working.

The Rev. Mr. Hodgson informed me, that on pounding some common Newcastle coal fresh from the mine in a cask furnished with a small aperture, the gas from the aperture was inflammable. And on breaking some large lumps of coal under water, I ascertained that they gave off inflammable gas *. Gas is likewise disengaged from bituminous shist, when it is worked.

The great sources of the fire-damp in mines are, however, what are called blowers, or fissures in the broken strata, near dykes, from which currents of fire-damp issue in considerable quantity, and sometimes for a long course of years †. When old workings are broken into, likewise, they are often found filled with fire-damp; and the deeper the mine the more common in general is the substance.

I have analysed several specimens of the fire-damp in

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* This is probably owing to the coal strata having been formed under a pressure greater than that of the atmosphere, so that they give off elastic fluid when they are exposed to the free atmosphere: and probably coals containing animal remains, evolve not only the fire-damp, but likewise azote and carbonic acid, as in the instance of the gas sent by Dr. Clanny.

In the Apennines, near Pietra Mala, I examined a fire produced by gaseous matter, constantly disengaged from a shist stratum: and from the results of the combustion, I have no doubt but that it was pure fire-damp. Mr. M. Faraday, who accompanied me, and assisted me in my chemical experiments, in my journey, collected some gas from a cavity in the earth about a mile from Pietra Mala, then filled with water, and which, from the quantity of gas disengaged, is called Aqua Buja. I analysed it in the Grand Duke's laboratory at Florence, and found that it was pure light hydro-carbonate, requiring two volumes of oxygen for its combustion, and producing a volume of carbonic acid gas.

It is very probable, that these gases are disengaged from coal strata beneath the surface, or from bituminous shist above coal; and at some future period new sources of riches may be opened to Tuscany from this invaluable mineral treasure, the use of which in this country has supplied such extraordinary resources to industry.

† Sir James Lowther found a uniform current produced in one of his mines for two years and nine months. Phil. Trans. Vol. XXXVIII. p. 112.

the laboratory of the Royal Institution; the pure inflammable part was the same in all of them, but it was sometimes mixed with small quantities of atmospherical air, and in some instances with azote and carbonic acid.

Of six specimens collected by Mr. Dunn from a blower in the Hepburn Colliery, by emptying bottles of water close to it, the purest contained one-fifteenth only of atmospherical air, with no other contamination, and the most impure contained five-twelfths of atmospherical air; so that this air was probably derived from the circumambient air of the mine. The weight of the purest specimen was for 100 cubical inches 19.5 grains.

One measure of it required for its complete combustion by the electric spark nearly two measures of oxygen, and they formed nearly one measure of carbonic acid.

Sulphur heated strongly, and repeatedly sublimed in a portion of it, freed from oxygen by phosphorus, produced a considerable enlargement of its volume, sulphuretted hydrogen was formed, and charcoal precipitated; and it was found that the volume of the sulphuretted hydrogen produced, when it was absorbed by solution of potassa, was exactly double that of the fire-damp decomposed.

It did not act upon chlorine in the cold; but when an electric spark was passed through a mixture of one part of it with two of chlorine, there was an explosion, with a diminution to less than one-fourth, and much charcoal was deposited.

The analysis of specimens of gas sent to my friend John George Children, Esq. by Dr. Clanny, afforded me similar results; but they contained variable quantities of carbonic acid gas and azote.

Different specimens of these gases were tried by the test of exposure to chlorine both in darkness and light: they exhibited no marks of the presence of olefiant gas or hydrogen; and the residuum produced by detonation with chlorine showed them to be free from carbonic oxyd.

It is evident then, that the opinion formed by other chemists respecting the fire-damp is perfectly correct; and that it is the same substance as the inflammable gas of marshes, the exact chemical nature of which was first demonstrated by Mr. Dalton; and that it consists, according to my view of definite proportions, of four proportions of hydrogen in weight four, and one proportion of charcoal in weight 11.5.

I made several experiments on the combustibility and explosive nature of the fire-damp. When one part of fire-damp was mixed with one of air, they burnt by the approach of a lighted taper, but did not explode; two of air and three of air to one of gas produced similar results. When four of air and one of gas were exposed to a lighted candle, the mixture being in the quantity of six or seven cubical inches in a narrow necked bottle, a flame descended through the mixture, but there was no noise: one part of gas inflamed with six parts of air in a similar bottle, produced a slight whistling sound: one part of gas with eight parts of air, rather a louder sound: one part with ten, eleven, twelve, thirteen, and fourteen parts, still inflamed, but the violence of combustion diminished. In one part of gas and fifteen parts of air, the candle burnt without explosion with a greatly-enlarged flame; and the effect of enlarging the flame, but in a gradually diminishing ratio, was produced as far as thirty parts of air to one of gas.

The mixture which seemed to possess the greatest explosive power was that of seven or eight parts of air to one of gas; but the report produced by fifty cubical inches of this mixture was less than that produced by one-tenth of the quantity of a mixture of two parts of atmospherical air and one of hydrogen.

It was very important to ascertain the degree of heat required to explode the fire-damp mixed with its proper proportion of air.

I found that a common electrical spark would not explode five parts of air and one of fire-damp, though it exploded six parts of air and one of damp: but very strong sparks from the discharge of the Leyden jar, seemed to have the same power of exploding different mixtures of the gas as the flame of the taper. Well burned charcoal, ignited to the strongest red heat, did not explode any mixture of air and of the fire-damp; and a fire made of well-burned charcoal, *i.e.* charcoal that burned without flame, was blown up to whiteness by an explosive mixture containing the fire-damp, without producing its inflammation. An iron rod at the highest degree of red heat, and at the common degree of white heat, did not inflame explosive mixtures of the fire-damp; but, when in brilliant combustion, it produced the effect.

The flame of gaseous oxyd of carbon, as well as of olefiant gas, exploded the mixtures of the fire-damp.

In respect of combustibility, then, the fire-damp differs most materially from the other common inflammable gases. Olefiant gas, which I have found explodes mixed in the same proportion with air, is fired by both charcoal and iron heated to dull redness. Gaseous oxyd of carbon, which explodes when mixed with two parts of air, is likewise inflammable by red hot iron and charcoal. And hydrogen, which explodes when mixed with threesevenths of its volume of air, takes fire at the lowest visible heat of iron and charcoal; and the case is the same with sulphuretted hydrogen.

I endeavoured to ascertain the degree of expansion of mixture of fire-damp and air during their explosion, and likewise their power of communicating flame through apertures to other explosive mixtures.

I found that when six of air and one of fire-damp were exploded over water by a strong electrical spark, the explosion was not very strong, and, at the moment of the greatest expansion, the volume of the gas did not appear to be increased more than half.

In exploding a mixture of one part of gas from the distillation of coal, and eight parts of air in a tube of a quarter of an inch in diameter and a foot long, more than a second was required before the flame reached from one end of the tube to the other; and I could not make any mixture explode in a glass tube one-seventh of an inch in diameter: and this gas was more inflammable than the fire-damp, as it consisted of carburetted hydrogen gas mixed with some olefiant gas.

In exploding mixtures of fire-damp and air in a jar connected with the atmosphere by an aperture of half an inch, and connected with a bladder by a stop-cock, having an aperture of about one-sixth of an inch *, I found that the flame passed into the atmosphere but did not communicate through the stop-cock, so as to inflame the mixture in the bladder: and in comparing the power of tubes of metal and those of glass, it appeared that the flame passed more readily through glass tubes of the same

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* Since these experiments were made, Dr. Wollaston has informed me, that he and Mr. Tennant have observed some time ago, that mixtures of the gas from the distillation of coal and air, would not explode in very small tubes.

diameter; and that explosions were stopped by metallic tubes of one-fifth of an inch [*], when they were one inch and a half long; and this phenomenon probably depends upon the heat lost during the explosion in contact with so great a cooling surface, which brings the temperature of the first portions exploded below that required for the firing of the other portions. Metal is a better conductor of heat than glass: and it has been already shown that the fire-damp requires a very strong heat for its inflammation.

Mixture of the gas with air I found likewise would not explode in metallic canals or troughs, when their diameter was less than the one-seventh of an inch, and their depth considerable in proportion to their diameter; nor could explosions be made to pass through such canals.

Explosions likewise I found would not pass through very fine wire sieves or wire gauze.

I mixed azote and carbonic acid in different quantities with explosive mixtures of fire-damp, and I found that even in very small proportions they diminished the velocity of the inflammation. Azote, when mixed in the proportion of one to six of an explosive mixture, containing twelve of air and one of fire-damp, deprived it of its power of explosion; when one part of azote was mixed with seven of an explosive mixture, only a feeble blue flame slowly passed through the mixture.

One part of carbonic acid to seven of an explosive mixture deprived it of the power of exploding; so that its effects are more remarkable than those of azote; probably, in consequence of its greater capacity for heat, and probably, likewise, of a higher conducting power connected with its greater density.

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[*] I do not give this result as perfectly exact, as the bore of the metallic tube had not the same polish as that of the tube of glass.

The consideration of these various facts led me to adopt a form of a lamp, in which the flame, by being supplied with only a limited quantity of air, should produce such a quantity of azote and carbonic acid, as to prevent the explosion of the fire-damp, and which, by the nature of its apertures for giving admittance and exit to the air, should be rendered incapable of communicating any explosion to the external air.

If in a close lantern, supplied with a small aperture below and another above, a lighted lamp having a very small wick be placed, the natural flame gradually diminishes, till it arrives at a point at which the supply of air is sufficient for the combustion of a certain small quantity of oil; if a lighted taper be introduced into the lanthern through a small door in the side, which is instantly closed, both lights will burn for a few seconds, and be extinguished together.

A similar phenomenon occurs, if, in a close lantern, supplied with a quantity of air merely sufficient to support a certain flame, a mixture of fire-damp and air is gradually admitted, the first effect of the fire-damp is to produce a larger flame round that of the lamp, and this flame, consuming the oxygen which ought to be supplied to the flame of the lamp, and the standard of the power of the air to support flame being lowered by the admixture of fire-damp and by its rarefaction, both the flame of the fire-damp and that of the taper are extinguished together; and as the air contained a certain quantity of azote and carbonic acid before the admission of the fire-damp, their effect, by mixing with it, is such as to prevent an explosion in any part of the lantern.

I tried several experiments on the burning of a flame in atmospheres containing fire-damp. I inclosed a taper in a little close lantern, having a small aperture below and

a larger

a larger one above, of such size that the taper burnt with a flame a little below its natural size. I placed this lantern, the taper being lighted, on a stand under a large glass receiver standing in water, having a curved tube containing a little water, adapted to its top to confine the air, and which was of such a capacity as to enable the candle to burn for some minutes; I then rapidly threw a quantity of fire-damp into the receiver from a bladder, so as to make the atmosphere in it explosive. As the fire-damp mixed with the air, the flame of the taper gradually enlarged, till it half filled the lantern; it then rapidly diminished, and was suddenly extinguished without the slightest explosion. I examined the air of the receiver after the experiment, and found it highly explosive.

I tried similar experiments, throwing in mixtures of air and fire-damp, some containing the maximum, and others the minimum of fire-damp necessary for explosion, and always with the same satisfactory results. The flame considerably increased, and was soon extinguished.

I introduced a lighted lantern, to which air was supplied by two glass tubes, of one-tenth of an inch in diameter and half an inch long, into a large jar, containing an explosive mixture of one part of fire-damp and ten parts of air; the taper burnt at first with a feeble light, the flame soon became enlarged, and was then extintinguished. I repeated these experiments several times, and with a perfect constancy of result.

It is evident then, that to prevent explosions in coal mines, it is only necessary to use air-tight lanterns, supplied with air from tubes or canals of small diameter, or from apertures covered with wire gauze placed below the flame, through which explosions cannot be communicated, and having a chimney at the upper part, on a similar system for carrying off the foul air; and common lanterns may be easily adapted to the purpose, by being made air-tight in the door and sides, by being furnished with the chimney, and the system of safety apertures below and above.

The principle being known, it is easy to adopt, and multiply practical applications of it.

The first safe lantern that I had constructed was made of tin-plate, and the light emitted through four glass plates in the sides. The air was admitted round the bottom of the flame from a number of metallic tubes of one-eighth of an inch in diameter, and an inch and a half long. The chimney was composed of two open cones, having a common base, perforated with many small apertures, and fastened to the top of the lantern, which was made tight in a pneumatic rim, containing a little oil, the upper and lower apertures in the chimney were about one-third of an inch: the lamp, which was fed with oil, gave a steady flame, of about an inch high and half an inch in diameter. When the lantern was slowly moved, the lamp continued to burn, but more feebly, and when it was rapidly moved it went out. To obviate this circumstance, I surrounded the bottom of the lantern with a perforated rim; and this arrangement perfectly answered the end proposed.

I had another chimney fitted to this lantern, furnished with a number of safety tin-plate tubes, of the sixth of an inch in diameter and two inches long: but they diminished considerably the size of the flame, and rendered it more liable to go out by motion; and the following experiments appear to show, that if the diameter of the upper orifice of the chimney be not very large, it is scarcely possible that any explosion produced by the flame can reach it.

I threw into the safe lantern with the common chimney a mixture of fifteen parts of air and one of fire-damp: the flame was immediately greatly enlarged, and the flame of the wick seemed to be lost in the larger flame of the fire-damp. I placed a lighted taper above the orifice of the chimney: it was immediately extinguished, but without the slightest previous increase of its flame, and even the wick instantly lost its fire by being plunged into the chimney.

I introduced a lighted taper into a close vessel containing fifteen parts of air and one of gas from the distillation of coal, suffered it to burn out in the vessel, and then analyzed the gas. After the carbonic acid was separated, it appeared, by the test of nitrous gas, to contain nearly one-third of its original quantity of oxygen; but detonation, with a mixture of equal parts of hydrogen and oxygen, proved that it contained no sensible quantity of carburetted hydrogen gas.

It is evident, then, that when in the safe lantern, the air gradually becomes contaminated with fire-damp, this fire-damp will be consumed in the body of the lantern; and that the air passing through the chimney cannot contain any inflammable mixture.

I made a direct experiment on this point. I gradually threw an explosive mixture of fire-damp and air into the safe lantern from a bladder furnished with a tube which opened by a large aperture above the flame; the flame became enlarged, and by a rapid jet of gas I produced an explosion in the body of the lantern; there was not even a current of air through the safety tubes at the moment, and the flame did not appear to reach above the lower aperture of the chimney; and the explosion merely threw out from it a gust of foul air.

The second safety lantern that I have had made is upon the same principle as the first, except that instead of tubes *safety canals* are used, which consist of close concentric hollow metallic cylinders of different diameters, and placed together so as to form circular canals of the diameter of from one twenty-fifth to one fortieth of an inch, and an inch and seven-tenths long, by which air is admitted in much larger quantities than by the small tubes. In this arrangement there is so free a circulation of air that the chimney likewise may be furnished with safety canals.

I have had lamps made for this kind of lantern which stand on the outside, and which may be supplied with oil and cotton without any necessity of opening the lantern; and in this case the chimney is soldered to the top, and the lamp is screwed into the bottom, and the wick rises above the air canals.

I have likewise had glass lamps with a single wick, and Argand lamps made on the same principle, the chimney being of glass, covered with a metallic top, containing the safety canals, and the air entering close to the flame through the circular canals.

The third kind of safe lamp or lantern, and which is by far the most simple, is a close lamp or lantern, into which the air is admitted, and from which it passes, through apertures covered with *brass wire gauze* of one two hundredth of an inch in thickness, the apertures of which should not be more than $\frac{1}{120}$ of an inch; this stops explosions as well as long tubes or canals, and yet admits of a free draught of air.

TO BE CONCLUDED IN OUR NEXT.

On

On the Preservation of Fruits during Winter and Spring.

By Mr. T. A. KNIGHT.

From the TRANSACTIONS of the HORTICULTURAL SOCIETY.

THE art of preserving fruits for the desert in Winter and Spring, appears to be better understood, or at least to be practised with better success, by the gardeners of the Continent, than by those of the British Islands; and it becomes a very interesting subject of enquiry, whether the superior success of the continental gardeners be dependent upon the superior qualities of their fruits, or upon the influence of a less humid atmosphere during Winter; or upon some peculiarities of management.

Fruits which have grown upon standard trees, in climates sufficiently warm and favourable to bring them to maturity, are generally more firm in their texture, and more saccharine, and therefore more capable of being long preserved sound, than such as have been produced by wall-trees; and a dry and warm atmosphere also operates very favourably to the preservation of fruits under certain circumstances; but under other circumstances, very injuriously; for the action of those elective attractions, which occasion the decay and decomposition of fruits, is suspended by the operation of different causes in different fruits; and even in the same fruit, in different states of maturity. When a grape is growing upon the vine, and till it has attained perfect maturity, it is obviously a living body, and its preservation dependent upon the powers of life; but when the same fruit has some time passed its state of perfect maturity, and has begun to shrivel, the powers of life are probably no longer, or at most very feebly, in action; and the fruit appears to be then preserved by the combined operation of its cellular texture, the anti-septic powers of the saccharine matter it contains, and by the exclusion of air by its external skin; for if that be destroyed, it immediately perishes. If longer retained in a dry and warm temperature, the grape becomes gradually converted into a raisin; and its component parts are then held in combination by the ordinary laws only of chemistry.

A Nonpareil Apple, or a Catillac, an Auch, or Bergamotte de Bugi Pear, exhibits all the characters of a living vegetable body long after it has been taken from the tree, and appears to possess all the powers of other similar vegetable bodies, except that of growing, or vitally uniting to itself other matter; and the experiments, which I shall proceed to state, prove that the Pear is operated upon by external causes nearly in the same manner after it has been detached from the tree as when it remains vitally united to it.

Most of the fine French Pears, particularly the Auch, are much subject, when cultivated in a cold and unfavourable climate, to crack before they become full grown upon the trees, and consequently to decay before their proper season, or state of maturity; and those which present these defects in my garden are therefore always taken immediately from the trees to a vinery, in which a small fire is constantly kept in Winter, and they are there placed at a small distance over its flue. Thus circumstanced, a part of my crop of Auch Pears ripen, and will perish if not used in November, when the remainder continue sound and firm till March or April, or later; and the same warm temperature which preserves the Grape in a slightly shrivelled state till January, rapidly accelerates the maturity, and consequent decay, of the Pear. By gathering a part of my Swan's Egg Pears early

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in the season, (selecting such as are most advanced towards maturity,) and subjecting them, in the manner above mentioned, to artificial heat, and by retarding the maturity of the later part of the produce of the same trees, I have often had that fruit upon my table nearly in an equal state of perfection from the end of October to the beginning of February; but the most perfect in every respect have been those which have been exposed in the vinery to light and artificial heat as soon as gathered.

The most successful method of preserving Pears and Apples which I have hitherto tried has been placing them in glazed earthen vessels, each containing about a gallon, (called provincially *steens,*) and surrounding each fruit with paper; but it is probable that the chaff of oats, if free from moisture or any offensive smell, might be used with advantage instead of paper, and with much less expense or trouble. These vessels being perfect cylinders, about a foot each in height, stand very conveniently upon each other, and thus present the means of preserving a large quantity of fruit in a very small room; and if the spaces between the top of one vessel and the base of another, be filled with a cement composed of two parts of the curd of skimmed milk and one of lime, by which the air will be excluded, the later kinds of Apples and Pears will be preserved with little change in their appearance, and without any danger of decay, from October till February and March. A dry and cold situation, in which there is little change of temperature, is the best for the vessels; but I have found the merits of the Pears to be greatly increased by their being taken from the vessels about ten days before they were wanted for use, and being kept in a warm room; for warmth at this, as at other periods, accelerates the maturity of the Pear. The same agent accelerates its decay also; and a warmer climate cannot contribute to the superior success of the French gardeners; which probably arises only from the circumstance of their fruit being the produce of standard, or espalier trees.

I have in a former communication given an opinion, that good varieties of hardy Winter Pears, which will succeed without the protection of walls, may be easily obtained by propagating from the seeds of the best and hardiest varieties of Winter Pears that we now possess, and the pollen of the best French Pears: and I have subsequently raised several hundred seedling plants, which, by their foliage and general character, promise the most ample success. Many years must however elapse, probably more than I shall live to see, before the greater part of these will produce fruit; but I trust that the plants will not be neglected by those to whose care I shall entrust them, and that the produce of some of them will be hereafter honoured by the approbation of the Horticultural Society.

An Account of a Method of growing Mushrooms under Glass. By Mr. Steeven Jeeves, *Gardener to the Hon.* Thomas Brand.

From the Transactions of the London Horticultural Society.

ALTHOUGH it is probable that the method of growing mushrooms which I have pursued these four months past is well known to many of the Fellows of the Horticultural Society, and may have been practised by other gardeners, yet, as it has not, I believe, been publickly communicated, I hope the following statement may be acceptable.

Not having a shed which could be conveniently adapted to the plan directed by Mr. Oldacre in his printed account of the method practised in raising mushrooms in Russia, without considerable expense in making a flue and erecting stages, it occurred to me, that the pit of a small stove (hitherto used for forcing flowers) might be applied to a similar purpose.

To make my bed, the dung was placed in the bottom of the pit; and rammed tightly down to about the thickness of eighteen inches; the dung itself producing sufficient heat to set the spawn running, after it had been introduced in the usual manner; the bed was made up last September; and came into bearing in six weeks; has continued to produce regularly to the present time, and requires no more heat than is collected by the effect of the sun on the air within the house, except on frosty nights, when a little fire is put into the flue.

The mushrooms come up uniformly over every part of the bed, which is covered very slightly with straw, (not sufficient to exclude the light,) for the purpose of preserving moisture on the surface.

The spawn was obtained from the natural plant in the fields, in October 1814, and was kept in lumps of earth, in a dry room, till it was used. In growing it, however, by this method, it is requisite to be particularly careful to select it from places where the true mushroom alone grows, lest a bad sort, or other noxious fungi, be introduced thereby into the bed.

When a daily supply is not wanted, this method of raising mushrooms might be adopted, and a sufficient quantity for a small family, raised by putting the dung and spawn into boxes of such a size as might be conveniently placed on the shelves, or other parts of green-houses or conservatories.

On a remarkable Property of the Hoya Carnosa *.

By Mr. JOHN MAHER, *F. H. S. &c.*

From the TRANSACTIONS of the LONDON HORTICULTURAL SOCIETY.

AS it does not appear that any notice has hitherto been taken of the very singular preference which the greater number of Summer insects evinee for the blossoms of the Hoya Carnosa, in situations where their favourite fruits are both abundant and well ripened, I trust the following observation may not be deemed unacceptable to Horticulturists; since I am lead to believe, that if this plant were generally introduced into graperies, it would altogether set aside the necessity of using bags.

At the same time that a flourishing plant of the Hoya Carnosa was blooming in a hot-house at Millfield, near Edmonton, some healthy vines were loaded with ripe fruit in a grapery immediately adjoining; the door communicating with the said hot-house being kept constantly open.

At this time I daily remarked, that while the blossoms of the Hoya attracted innumerable wasps, bees, and other insects, the Grapes remained altogether untouched. The honied exudations of the Hoya are therefore evidently preferred by insects to the pulp of those fruits which they so commonly destroy. And it would appear, that this plant might with advantage be made the general inmate of the forcing-house.

The individual plant alluded to was introduced from China about ten years since; and has now extended its shoots to the length of twenty-four feet.

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* This plant was, when first introduced, called Asclepias carnosa.

On the Forcing of Sea-cale.

By Mr. William Gibbs, *Inverness.*

From the Transactions of the Caledonian Horticultural Society.

As I have not seen any thing in the Society's Memoirs on the forcing of sea-cale, I have sent you an account of the method I have tried. I doubt not but by farther trials considerable improvements may be made on this mode; but at present I have it not in my power to pursue it further.

It occurred to me, that sea-cale might be forced in a manner similar to asparagus, and I resolved to try the experiment.

I prepared a hot-bed in the same manner as for asparagus; when the heat became moderate, I put a little light earth on the surface of the bed; then took strong plants of sea-cale, three or four years old, which were taken up with as good roots as possible, and placed them closely together on the bed, covering them in with such earth as is used for cucumbers. I then put on the glass, which I covered with double mats, in order to exclude light. In a few days the plants began to grow, and in about a fortnight a good many of the stalks were fit for use; and they continued to come in succession for two months.

The size of the stalks did not seem to be stinted or diminished by the removal of the plants; they were well blanched, tender, and in every respect as good as those forced by any other method; besides, a greater quantity was obtained in this way than could be had by the common method, and the expense of labour and dung was far less. Although I used glass and mats, (having no

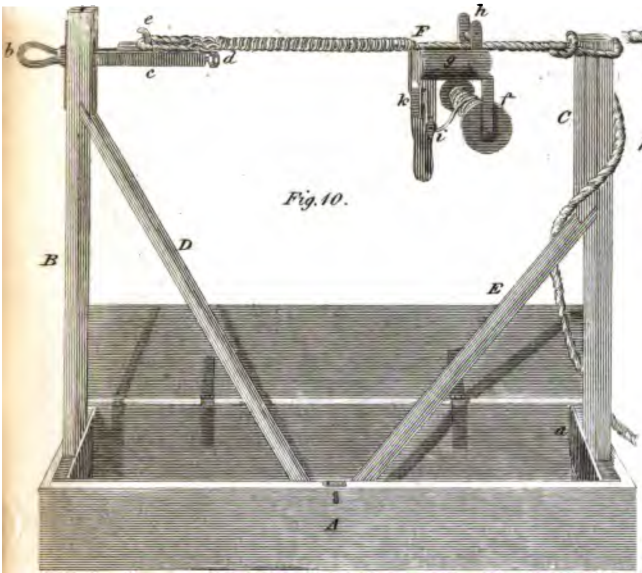


Fig. 10.

Fig. 11.

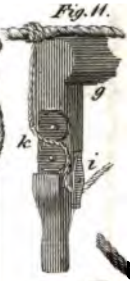
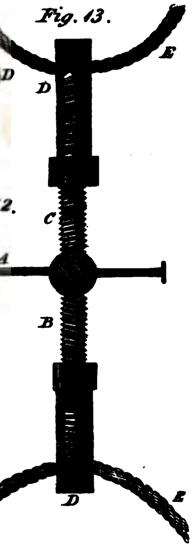


Fig. 13.



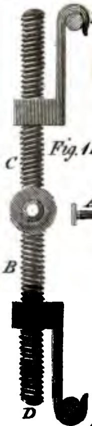


Fig. 12.

Mr. Adams's Patent.

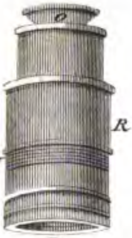


Fig. 9.

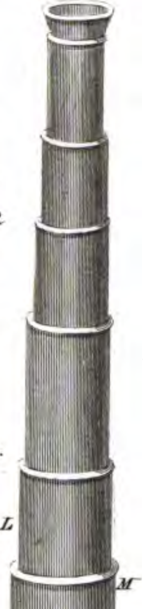


Fig. 8.

Fig. 4.

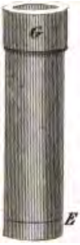
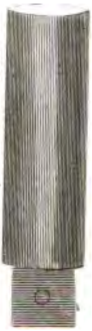


Fig. 6.

Fig. 5.

Fig. 7.

Fig. 3.



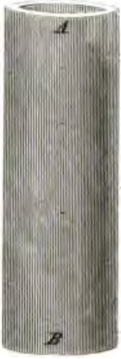


Fig. 1.
From 9 to 12 Inches

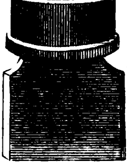


Fig. 2.

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other covering at hand,) I suppose boards, or any other covering that will exclude a considerable portion of air and light, will be found to answer completely.

The plants that have been forced in this manner would not be fit for forcing the succeeding season unless they were to remain in the same place to acquire strength, but, from being close on the bed, they would not have sufficient space to get strong; therefore the best way to keep up a succession is, to have at hand a considerable store of seedling plants in successive beds, a small bed being sown every year. The seeds may be sown in rows about two feet apart, and the plants thinned out to a proper distance in the row. These, when three years old, may be taken up and forced in the manner above mentioned.

It appears to me, that sea-cale may be had in this way fit for use in any quantity, at any season, at less expense, and with greater certainty, than by any other method that I have seen or heard of.

On the Renovation of old Peach Trees in Hot-houses; and on destroying the Blue Insect on Apple Trees.

By Mr. Alexander Hay, *Gardener, Newliston.*

From the Transactions of the Caledonian Horticultural Society.

I. *Renovation of old Peach Trees.*

WHEN I came here in the beginning of June 1812, I found the trees in two large houses in the worst state possible; in particular, they were over-run with coccus and red spider; and, what was much worse, there was not a young shoot upon them but what was mildewed its whole length; the few fruit on them being entirely covered with it, so as to render them useless. I saw there was no good to be expected from such wood next year; and my master being anxious to save the old trees, and recover them if possible, I resolved to make the attempt. I was satisfied that the ordinary mode of dusting the leaves in summer with flowers of sulphur was but a temporary remedy. I therefore resolved to apply this powerful substance in a liquid form, or in the state of a paint. I took two pounds of flowers of sulphur, two pounds of soft soap, and mixed them well together, with as much boiling water as brought the mixture to the consistency of a paint: I then untied the trees, and cut back every mildewed shoot, to two or three eyes; brushed the trees clean, and washed them with a sponge, dipt in soap-suds. I then anointed them with the above mixture, taking care not to miss a single bit of them, old wood and new. The mixture should be allowed to remain as long as possible on the trees, in order that it may act the more completely. I dressed them again to the trellis, forked over the surface of the borders, and gave them a hearty watering with dunghill drainings.

The above operation was performed in the beginning of June; but, it is to be understood, the mixture may be applied at any season of the year. I gave the houses very little air through the day, and kept the thermometer about 74° in the night, till the young shoots that were cut back began to push; gradually letting it down to 55°, at which I kept it nearly for the season, giving plenty of air through the day. The trees made much better wood than I expected, and which, with the help of the flues in autumn, was pretty well ripened.

The following winter I lifted the border-soil the whole depth and breadth, to within two feet of the trees, replacing the old earth with the following compost: one-half strong loam, one-fourth vegetable mould, and one-fourth well rotted stable dung. I then gave the trees their winter dressing, at the same time anointing them with the mixture.

In 1813 I did not begin forcing till the buds were swelling, and then gave no more heat than I thought would resist frost or damp. We had a middling abundant crop, and of fine fruit; the trees made excellent wood, which ripened well; and this year (1814) they have as fine an appearance of a crop as I have ever seen, and not the smallest vestige of mildew or vermin of any kind has been on them since their first dressing with the mixture. The trees are upwards of twenty-four years old, and have been forced every year.

If the mildew has been brought on trees with age and bad treatment, which was the case here, the above mixture, and renewing the borders, will complete their cure; but it will be necessary to anoint every winter. If it is from a wet or bad bottom, nothing will do them any good till a kindly bed is made for their roots.

Wounds in peach, or indeed in stone-fruit trees of any kind, are effectually prevented from cankering, by being laid over with the mixture, and then coated over with tar. I have repeatedly tried this plan, and never once found it fail.

II. *Blue Insect on Apple Trees.*

When the new gardens at Edmonstone were made in 1809, my then worthy master, the late John Wauchope, Esq. wished to have the greater part of his trees from the London nurseries; accordingly they were commissioned, and came safe, in good time for planting, in the beginning of 1810. On unpacking the apple tree I observed a mouldiness all over the plants, but not being acquainted with the blue insect, never having seen it before, I thought it had been contracted in their passage. I planted them without thinking any thing was wrong. As soon as the trees began to vegetate I observed them getting worse every week, and in a short time they were quite over-run. I immediately had the trees taken from the wall, brushed and washed all over with a mixture of soft soap, sulphur, and tobacco juice. A pound of each, mixed in about a Scots quart of soft water, was what I used. I saw nothing more of the insects till August following, when they again made their appearance. I again repeated the dose, cleared them off a second time, and thought all was well, as there was nothing of them seen the following winter. In spring 1811, as soon as the trees began growing, I looked frequently over them, and observed the insects some time in May, principally near the lower parts of the trees; but before the end of June the trees were as bad as ever. I then saw it was an endless business to clean the external parts of the trees, as it was evident, from their being first seen on their under parts, that the insects were lodged in the roots, and proceeded upwards with the juices of the tree.

In the beginning of July, I repeated the former operation, and at the same time opened the earth about their roots, cleared them as well as I could, not to loosen them, and having a large quantity of the following mixture ready, *viz.* about forty Scots pints of soap-suds collected from the washing-house, the juice of four pounds roll tobacco, four pounds of flowers of sulphur, I gave each tree about one Scotch pint of it, gave it time to absorb, and closed the earth about it.

I happened to leave the place at Whitsunday, 1812; and from the above date, *viz.* July 1811, there was not the slightest vestage of them seen.

I called at Edmonstone in October 1813, examined the trees, and found them quite clean; at the same time the gardener who succeeded told me he had seen nothing of them since he came there.

I am inclined to believe, that summer is the most proper time for the above operation, as the juices are then in motion, and seem to be much more easily acted upon than when they are in a dormant state.

I may add, that if any gentleman should chance to get trees that are suspicious, it would be worth while to wash them all over, and soak their roots a considerable time in the above mixture before planting.

On the Management of Cherry Trees. By Mr. WALTER UNDERWOOD, *Gardener, Eglinton Castle.*

From the TRANSACTIONS of the CALEDONIAN HORTICULTURAL SOCIETY.

I HAVE often observed, when the branches of cherry trees are laid in too near to one another, or are crossed by branches of the same kind, or by plum tree branches, as is sometimes the case, that although there be abundance of blossom, yet there is no crop, even in good seasons.

This led me to investigate the cause of the failure, and, on examining the blossom, I found that in fifty flowers there were not above two styles, of course no fruit could be expected.

It occurred to me, that it must be the want of light and air to ripen the flower-buds, which, if not thoroughly ripened in any kind of trees, it will be in vain to look for fruit.

I have for several years past, as soon as the cherries were set, and the young fruit began to swell, gone regularly over every spur, and carefully picked off every remainder of decayed blossom, and also all weak fruit, which did not appear likely to stand. I give the trees a strong washing with the engine, throwing the water with considerable force, yet so as not to drive off the young fruit; and before I put on the nets to preserve the fruit I clear off all superfluous shoots. As soon as the crop is gathered I take off any late shoots that may be on the trees, and give them another complete washing with the engine. Where any of the spurs are much darkened by the leaves I pick a few off, to let in the light. Since I have practised these methods, I have never failed of having a plentiful crop of this most delicious fruit.

I have repeatedly proved the advantage of this mode of proceeding with trees whose branches are laid in too close, by leaving a tree untouched: wherever the tree was so left I have invariably found very few fruit.

M. MOLARD's *Report on Leaden Pipes made without soldering. By M. Le* BAILLIF.

From the BULLETIN DE LA SOCIETE', &c.

M. LE BAILLIF having intimated to the Society that he was able to make leaden pipes without soldering, of different diameters and various lengths, of an even surface, both internally and externally, capable of bending without breaking, and consequently as perfect as can be desired; he invited a Committee of the Society to visit his manufactory, in order to ascertain whether, by the methods he uses, these pipes may be made as perfect as he describes, without augmenting the expense.

M. le Baillif's method, and the results of the examination, are as follows. The pipes, in the first instance, are run upon an iron cylinder, within a copper mould, of about two yards long, composed of two pieces, which are connected by hinges or loops, so that the mould may be opened in order to take out the pipes, and closed in order to receive fresh ones. In the mould, vent holes are made for the air to escape as the melted lead drives it forward; and in this manner pipes of the thickness of $0^{m}012$ may be always obtained without any defect in them. M. le Baillif uses a bench to draw out the tubes, as in wire drawing, and to draw out the mandril which has served as a core, for which he afterwards substitutes another of the same diameter, but much longer, having first greased it. He passes the leaden tube, thus fixed upon the mandril, through plates, graduated in the manner of those for wire drawing, and as practised for the tubes of telescopes. The length of the tube is augmented about $0^{m}35$ each time that it is passed through a fresh hole of the plate, and the thickness may be diminished to $0^{m}004$. M. le Baillif has endeavoured to diminish it still more; but then he could not draw the tubes off the mandril without deforming them.

To avoid this inconvenience we have advised M. le Baillif to place the tubes fixed upon the mandril between two straight planes, and to roll them by a pressure sufficient to augment sensibly the diameter of the tube. By this means the mandril may be easily withdrawn without deforming the tube, whatever may be its thickness. The tubes thus fabricated are smooth within and without, and of an equal thickness in every part, which allows of their being bent without breaking or flattening, using always the customary precautions.

On the Preparation of Mortar and Cement.

From the ANNALES DES ARTS, &c.

IF it were possible to construct our monuments of a single piece there is no doubt but they would be sufficiently strong to resist the attacks of the weather. But as this cannot be done, and as they are necessarily composed of separate pieces, the joints between the pieces have a tendency, with the water that enters them and the effect of frost, to destroy the force of cohesion, on which the stability of every edifice depends. In order therefore to connect the stones, and diminish the joints which separate them, various mortars or cements have been invented, with a view of uniting them into a single piece.

These mortars are differently composed in different countries; however, it has been universally discovered, that to unite two substances by means of a material which has but a small degree of cohesion, it is necessary to employ this material of as little thickness as possible. The great difficulty that is experienced in the preparation of mortar, depends on the force of aggregation that must be given to it; in short, it must not have less of it than the materials which it is to unite.

The principal substances of which mortar is composed are, 1st. lime, 2d. sand, 3d. pozzolane or volcanic ashes, 4th. bricks, earthen-ware, and pounded marbles, 5th. iron, and various scoria containing that metal, in a greater or less proportion.

It must be observed, that among the substances which enter into the composition of mortar, some are employed to bind it, and unite the materials which otherwise would not combine; and others serve solely, by their power of cohesion, to give firmness to the whole mass. It is evident that lime furnishes the binding principle and iron the strength.

In buildings which require to be of great strength, the Germans, in imitation of the antients, are careful to employ only stones that have been two years taken out of the quarries, in order that the water may have evaporated from them. It is well known, indeed, that stone hardens in the air, and that when newly cut from the quarries it saws with much greater ease. They are equally observant of the direction of the beds, for the pressure that falls on beds that lye horizontally is much greater than on those that are in a perpendicular position. For this reason the stone that is extracted from the thickest beds is generally the best, and the most solid. We cannot but deplore the ignorance of the quarry men in the South of France, who by their negligence leave a part of their exploitation submerged, and thus render excellent quarries useless. In the preparation of the lime, the Germans as well as ourselves have remarked, that the calcareous stones are good in proportion as they are pure; thus the white marbles and calcareous laminæ produce excellent lime. In preparing the lime they are always careful to break the calcareous stones, because these stones being indifferent conduetors of heat, require to be divided, that they may lose less heat.

They avoid in this manner the frit produced by the ashes, which almost always contain sand, alumine, and manganese. Finally, they almost always use perpetual kilns, disposing the calcareous stones in layers one upon another.

They employ the lime as speedily as possible after it comes from the kiln, especially when it is much burnt, because it then attracts the moisture more, and becomes quickly saturated with it. They have likewise discovered, that it is essential to preserve the lime from the air, of which the reason is easily seen. They judge of the good quality of the lime by the thickness with which it effervesces in water, and by the quantity of heat that it developes in it. Good lime should not leave any dust between the fingers when taken up by them, nor contain any carbonic acid. When it dissolves entirely and without effervescence in muriatic acid it is judged to be very pure, and to contain no foreign substance.

When the Germans slake their lime they have two reservoirs, one above the other, the upper one contains the water that is to fall upon the lime which is placed in the lower one; but they are not agreed as to the time that the lime requires to be penetrated with the water. Some think, that as it requires more than two years to combine with all the water that is necessary to it, it ought to macerate a long time, as otherwise it might swell, absorb the water, and consequently destroy the cement, of which it forms a part. Others, on the contrary, observe, that by leaving the lime a long time to macerate, it absorbs not only water but also carbonic acid from the atmosphere, and that afterwards, when they come to use it, it will not dissolve, which is a great inconvenience in the preparation of mortar. It is very true, that when lime is used to make mortar it must not be combined with carbonic acid, for in that case it certainly will not dissolve, and since this is the only soluble substance contained in mortar, this circumstance will prevent it from binding the mortar properly. But, on the other side, do they not know that the humid lime is more easily decomposed than when it is dry, because the affinity of water for lime is greater than the affinity of lime for carbonic acid. Indeed, it is of consequence that neither too much or too little water be given to the lime; for if it have too little it burns, as the workmen term it, and dissolves very badly; and if it have too much it prevents the cohesion of the mortar. They all agree to pour the water slowly on the lime as well as to agitate the water, in order to render its division as complete as possible.

The Germans, as well as ourselves, distinguish two sorts of lime, the rich and the meagre, or poor lime. The first being the most proper to produce good mortar requires less sand or cement, because it is the purest. The meagre lime, containing silex, alumine, and iron, saturates less sand than the rich, but it has the advantage of acquiring solidity immediately, even in water, which the rich lime has not. It is, therefore, frequently advantageous to mix the two sorts together; and when the calcareous substances which this mixture naturally affords are not found, it is easy to add to the poor lime the substances that are wanting in it.

In some parts of Germany they substitute with advantage for silex and alumine argillaceous earths, which contain these two materials. They are well aware, that manganese is not the cause of the poor lime, since the calcareous substances which do not contain it afford nevertheless excellent lime of this sort. In some parts they prepare the lime in some degree before they slake it entirely; this is done by breaking it, and when thus divided putting it into a basket that dips in water; a first effervescence immediately takes place, occasioned by the disengagement of the air; when the second effervescence commences the lime is taken out, and in this state they preserve it. This lime, without being entirely quenched, and having absorbed only a small quantity of water, is yet very proper to afford good mortar, and when wanted it is easily

slaked

slaked by the ordinary means. They are very careful to do it with pure water, for the water out of wells mostly contains a great number of salts, which are injurious to the cement; besides the sulphate of lime which it holds in solution is less hard than the carbonate of lime. The sands also which form a part of the different kinds of mortar, have a great influence on their quality, according to their form and degree of tenuity. River sand being generally quartzeous, and on that account the hardest and most angular, is almost always the best. Among the earthy sands, the best are the driest and the hardest to the touch; it is also usually necessary when these are used in monuments of importance, to separate them from the clay contained in them. It is probably, for this reason, that the Germans consider those sands to be the best which do not render water turbid. They also think the fine sands are the best, and that coarse sand is preferable to flints. This rule is generally right; but it depends entirely on the use to which the mortar is to be applied.

Experience has shewn in Germany and elsewhere, that different kinds of sand are only good in proportion as they are free from earth and clay. They are easily purified by washing, which carries off the earthy parts, especially the clay, which is the most injurious. As for the sea sand, the Germans have little opportunity of using it; and they also know that this sand cannot be employed, being too slimy, and retaining many deliquescent salts. Accordingly they use only four principal kinds of sand. 1st. vitreous sand, composed of silex and quartz; 2d. calcareous sand, composed of fragments of calcareous stone; 3d. metalline sand, composed of metallic fragments; 4th. small sand, which is but little employed in the fabrication of mortars, because it is generally too soft and too much mixed with earth: it is principally used to give the first polish to marble or alabasters.

They frequently make artificial sand, just as they prepare (very much in the large way) pumice and artificial stones. To make the artificial sand they mostly employ chippings of stone or *terre Franche*, kneaded into masses about the size of the fist, and burnt.

These calcined pieces are afterwards broken up, and reduced to a powder; in this state mixed with lime, in suitable proportions, they make excellent mortar. As the good quality of the mortar depends principally upon the quality of the sand, the Germans are careful to use their sand as soon as it comes out of the quarries, for they observe, that it becomes very soon earthy by exposure to the air; they have also observed, that sand that imbibes water does not augment in bulk, consequently it loses none in drying, and therefore it is essential not to put too much water in the composition of the mortar, since, putting this aside, the portion which, in combining with the lime, passes to a concrete state, only fills up the spaces between the grains of sand.

Pozzolane is generally employed in Germany in all buildings under water. Volcanic ashes, porous or compact lava, serve for the same purpose, and afford nearly the same advantages; also scoriae and all calcined substances, the grains of which are irregular, and contain iron; the Germans also employ with success the ashes of Tournai, a mixture of half calcined lime and oxyd of iron, all dross of iron and the residue of aquafortis, a sort of combination of ferruginous argile and nitre. Lately, on account of the scarcity of pozzolane, they have substituted in its place ferruginous clay, or schist, submitted to a great degree of calcination.

This

This artificial pozzolane succeeds excellently in all buildings under water. They also employ different kinds of ochre, as well as bricks and coarse earthen-ware, very much pulverised; in short, all substances approaching in nature to pozzolane (and generally composed of 50 to 55 parts of silex, 20 to 25 of alumine, 5 to 7 of lime, 20 to 25 of oxyd of iron) may be rendered very useful in forming mortars that are to be placed under water. Pozzolane contains also a little potash; and that which contains a certain quantity produces the best mortar. Perhaps it is owing to this that the cement of the distillers of aquafortis, which is a ferruginous clay mixed with potash, is one of the best that is known. As for the cements made of the white of egg, the caseous part of milk, the bile of bullocks, they have little durability, and can never be made into good mortar. They can only be useful in joining fine china and porcelain; and their high price is an obstacle to their being used in the large way.

The proportions used of the different substances employed in making mortars are in general very variable, perhaps in consequence of the little importance attached to these mixtures.

The proportions most constantly adhered to in Germany are two parts of sand or cement to one of lime; but the most intelligent builders are content at present to put one part of lime to seven of sand. This method, successfully practised, is perhaps the best.

The mortar they compose according to the purpose for which it is intended. Thus, when it is to unite large masses, they put but little mortar, which they make of fine sand, because then the mass gives more resistance than the mortar; they lay a bed as thin as possible, and are satisfied even with milk of lime when they fix pieces of columns one upon another. To strengthen the adhesion,

sion, they roughen the surfaces of the masses that are to be joined, in order to make little cavities for the mortar to lodge in, which afterwards renders the adhesion more complete. On the contrary, when they build with rough stones, the mortar is composed of four parts of coarse sand, three of fine sand, and one of lime; or rather of one part of flints, three of coarse sand, three of fine sand, and one of lime. Lastly, when it is used as stucco they employ fine sand only, being careful when they lay several coats to put on the least fine undermost, and to cover it successively with finer sand. They are likewise very particular in the nature and quality of the water they use in the mortar. Pure water is the most proper, because it is to be feared that water charged with any foreign substance might form new combinations, which would prevent the cohesion of the mortar. Water containing carbonic acid, appears to offer some advantages, because it would dissolve the calcareous mixture in the sand. But this water, saturated with carbonic acid, might also combine with the lime, and prevent its dissolution; for this reason pure water is preferable.

TO BE CONCLUDED IN OUR NEXT.

Experiments upon Zinc. By M. VOGEL.

From the JOURNAL DE PHYSIQUE.

M. VOGEL has undertaken a course of experiments upon zinc, in order to study afterwards the characters of its oxyd. He has examined, for this purpose, the black powder and the sub-sulphate of zinc. The results of his experiments are,

1. That a black powder is formed when zinc is dissolved in the sulphuric, muriatic, and acetic acids.

2. That nitric acid in which zinc is dissolved deposits only a reddish-yellow powder, which is oxyd of iron.

3. That the black powder, when sulphuric acid is employed, is composed of charcoal, iron, and sulphate of lead.

4. That the zinc employed in France contains no copper nor arsenic; but always a small quantity of lead.

5. That all attempts to form the protoxide of zinc have been unsuccessful, and that the existence of this oxyd becomes doubtful.

6. That the flowers of zinc of the apothecaries always contain more or less of carbonic acid.

7. That the yellow mildew which the white oxyd of zinc takes in a strong calcination does not always depend upon iron, nor upon a disengagement of oxygen.

8. Lastly, That there exists a sub-sulphate of zinc, a salt which is in brilliant pearly spangles, which is a little soluble in warm water and in all acids, and which, with the oxyd of zinc, forms a soluble salt.

Court of Chancery, Saturday July 27, 1816.

WALKER *v.* CONGREVE.

SIR Samuel Romilly complained of a breach of the injunction obtained by the plaintiff to restrain the defendant, Sir William Congreve, his servant or agents, from making, or causing to be made, or vending, certain barrels for preserving and conveying gunpowder, alleged to be imitations of machines or vessels for which he, the plaintiff, had procured a patent; and moved, that for so breaking the injunction the defendant be committed for a contempt.

The learned counsel was about to detail the grounds of his motion, when he was interrupted by Mr. Leach, who stated that he had a notice of motion to dissolve the injunction in question, and requested to be heard first. The Court could not understand the subject so well if argued upon the first motion as upon the last. He was prepared to contend, that there was no colourable imitation of the plaintiff's patent made by his client, and consequently that there was no breach of the injunction of the Court prohibiting such imitation.

Sir Samuel Romilly urged, that as an injunction had been granted, the infringement of which was complained of, the question of infringement should be first heard. The two motions were perfectly distinct. The Court might be treated with contempt by breaking its injunction while that injunction continued, even though the defendant might subsequently state sufficient reasons why it should never have been granted, or why it should be immediately dissolved. The notice of a motion to dissolve the injunction, therefore, had no claims to priority of hearing, as no decision upon it could determine the question of contempt arising out of its infringement.

Mr. Leach said he did not consider it a matter of much consequence which motion was heard first; but thought that neither of them could be heard to advantage while the models were not in Court. Not expecting the cause to come on so soon, he had not yet received the models, which he expected in a short time.

The Lord Chancellor.—That, Mr. Leach, is a different ground.

Sir Samuel Romilly then proceeded; and contended, that as an answer was given in to the plaintiff's bill by the defendant without obtaining an order to dissolve the injunction, even though that injunction should be immediately dissolved, the defendant had incurred the penalties of contempt by infringing it while in force. He had always understood that it was not competent for a party, when accused of contemning the authority of the Court by infringing its order, to plead in their justification that such an order to restrain should not have issued, that the patent which they were prohibited from imitating was not a good one, or that the machines which were alleged in the injunction to be copied from it were not imitations; yet such was the only defence contained in Sir William Congreve's answer.

The Lord Chancellor said, that there was nothing more clear or indisputable than what he was about to state. If a person procures a patent, going through the necessary forms, and obtains an injunction against an alleged infringement of it, his patent may still be found, upon examination, to be an improper one; but the defendant, against whom the injunction is decreed, has no right to break it, upon the ground that it should not have been granted. He might shew the Court reasons for dissolving

ing it; but he himself could have none for breaking it. Again, the injunction might be granted upon a defective affidavit, though upon a strong representation; but still the defendant would be bound by it, while it was in force, and would commit a contempt in disobeying it. In the third place, an injunction might issue against a public servant, who as such was not liable to the consequences of a private suit, and against whom an injunction should not therefore have been granted; but even here the authority of the Court must be respected, and the injunction dissolved by its own act, and not broken by the party whom it was issued to restrain. This was the clear doctrine of the Court; but when a motion was made for the penalties of contempt, all alleviating circumstances were matters for grave consideration. He would, therefore, hear first the other motion before he decided upon this.

In a short time after hearing Sir Samuel's motion for the plaintiff, the models of the defendant arrived, and

Mr. Leach moved his Lordship to dissolve the injunction. The learned Counsel stated three grounds upon which he laid claim to a decision in favour of the defendant. He would contend, first, that the specification of the plaintiff's patent, though it could be made out to be new, was not of such a nature as came within the statute of monopolies; or did not exhibit such proofs of skill and invention as entitled it to the protection of that law that encouraged the exertions of genius, by enabling its possessor to reap more exclusively its rewards. Every thing new was not an invention worthy of a patent, nor could every original former of a machine be called an inventor. He would argue, secondly, that the invention of the plaintiff, though of such importance as to come within the statute of monopolies, contained no novelty, as a similar machine was employed at Woolwich in 1791.

Thirdly.

Thirdly, he would show that the defendant's machines were both new and important. He had no right to restrain the defendant from the manufacture of those which he was making, as they were no imitation of the plaintiff's patent. The defendant, in his answer, submitted that he was not amenable for a contempt, as he was acting in a public capacity, and for the public service, while he superintended the making of the machines of which the patentee complained; but on that ground the learned Counsel did not wish to enter, as he was sure the Government was not disposed, on the part of the public, to take advantage of a private individual.

When the learned Counsel was about to read the patentee's specification, Mr. Walker, the patentee, begged leave to explain to the Court his invention, to exhibit specimens of his barrels themselves, and to show the great resemblance existing between them and those made by the defendant's orders.

The learned Counsel, after this explanation, went over the different heads of his argument. Every novelty was not an invention entitled to the protection of the statute of monopolies. A new principle must be discovered—skill and ingenuity must be exerted to entitle an inventor to a patent. The making of an old machine of new materials could not be a discovery; and the plaintiff could claim no protection for an invention, the only merit of which consisted in being made of brass instead of wood. When tea was first introduced into this country earthenware tea-pots were used: but could a person who made the first one of silver be entitled to a patent, restraining all his fellow-subjects from silver tea-pots except bought of him? Next it was said that the form was new: but was the invention of making a barrel like a cylinder worthy of being protected by the statute of monopolies? Well but, said the patentee, my barrel is strengthened with hoops; and was it a new thing, displaying great ingenuity, to strengthen a barrel with hoops? Was the circular aperture a great invention? No, but the method of shutting it was new: and what was the novelty of placing upon a circular aperture a common pot lid? The learned Counsel went over the different parts of the invention; and after showing that what was new was unimportant, contended, in the terms of his other two arguments, similar machines had been before used in the ordnance, and that Sir William Congreve had not imitated Mr. Walker's Patent. He concluded with observing, that Sir William Congreve did not consider he was infringing on the plaintiff's discovery. Since the injunction, he had refrained from making the barrels; but having received a letter from the Ordnance-office to forward some which had been made before for the public service, he forwarded them accordingly, considering it his public duty so to do.

Mr. Wilson, on the same side, said, Sir William Congreve resisted the injunction for the sake of the public, and not for his own advantage. Were the interests of the country to be delayed because an individual says, you are using my machine? But what could the plaintiff point out as original in his machines? It could not be in the aperture; it could not be in the hoops, nor in the manner of closing the mouth. It was sufficient to say, that upon the answer, the injunction ought to be dissolved. What was alleged to be done was not within the terms of the injunction. The injunction was to restrain Sir William Congreve, his workmen, servants, and agents, from making, or causing to be made, or vended, any more machines; and the affidavit of Sir William Congreve stated, that none of these machines had been made since the injunction was obtained.

Sir Samuel Romilly said, as to the application to dissolve the injunction, the first question asked on the other side was, could the plaintiff have a patent for this? Could he have a patent for a bung, for a hoop, for a lid? He was pretty sure that the plaintiff never attempted to get a patent for any of these things. The real question was, whether an individual, who combined all these things for the first time was entitled to a patent for them? It was not to be allowed, that each thing should be taken by itself, and then to say, for this one thing you cannot have a patent. The next question was, whether this was a new invention? His Lordship was to dispose of this only on the answer and affidavits, without taking into consideration the machines which had been shown. Now, he could not find it stated any where that machines had been before made to answer the same purposes by the same means; and, under these circumstances, he submitted that the plaintiff was entitled to keep the injunction, and that there had been a violation of the injunction.

Mr. Bell followed on the same side. He conceived it was not necessary to show that all the parts of the plaintiff's machine were new: the only question was, whether the combination was a novelty. Homer and Virgil were not inventors, as they only used words which were known before; but certainly they found out a very pretty way of stringing words together, and their works had very much entertained the public ever since. Again, it was not necessary to shew, that an invention was the result of long application or deep skill. He remembered that, many years ago, ladies wore flowered tabbies, which were considered a very ornamental dress. The method of working the flowers was discovered by mere accident: a man having spit on the floor placed his hot iron on it, and observed that it spread out into a kind of flower. He afterwards tried the experiment on linen, and found it produced the same effect. He then applied for a patent, on the ground of a new discovery; and having obtained it, he lived to make a very considerable fortune. A similar case was that of the steam-engine, where a boy, in order to shorten his own labour, tied a string with a knot from one part of a machine to another, which led to the most important improvement that had ever been known. The learned Counsel humbly conceived, that nothing like the plaintiff's machine had been hitherto used in practice. The only question was, how were flannel cartridges packed up by Government before? They were packed up in a common wooden barrel, and not in a metallic machine, like the plaintiff's: hence it must be admitted, that the plaintiff was the inventor, and he humbly conceived his Lordship would think that the plaintiff had made out his claim to a very useful invention.

Here the argument closed, and it being four o'clock, the Court rose.

Monday, July 29.

Mr. Blenman was heard on the part of the plaintiff against dissolving the injunction in this cause. The plaintiff did not allege against Sir William that he was selling the machines, but that he was supplying His Majesty's navy with them, to the prejudice of the plaintiff, who would otherwise be applied to by the Ordnance for his barrels.

The Lord Chancellor said, that in the plaintiff's bill it was alleged that the defendant was making the machines, and in the affidavit it was stated that he had supplied a vessel belonging to the East India Company with them, which amounted to a sale.

The learned Counsel continued, and went over the arguments of Mr. Leach on Saturday; contending that his criterion of an invention that deserved protection from the statute of monopolies was not just. The discovery of a new principle was not necessary to make out an invention, otherwise the manufacture of a piece of loadstone into the needle that guided mariners in their voyages did not deserve the name of an invention, because the properties of the loadstone were previously known. Neither was it necessary that all the parts of a machine should be original, otherwise acromatic telescopes were not an invention, because the different glasses taken separately were formerly known.

After the learned Counsel had made some farther observations, he was proceeding to read a letter of Mr. Perceval's regarding the plaintiff's machines, when Mr. Leach objected, as the document was not verified by affidavit.

The Lord Chancellor desired the Counsel of the party, if they thought these documents important, to verify them by affidavit before Wednesday morning, when he would hear the suit. The defendant might likewise verify the models.

At the request of Mr. Walker, it was understood that the defendants, instead of bringing models of the barrels made at Woolwich in 1791, should bring the barrels themselves.

His Lordship recommended, that before Wednesday persons appointed by both parties should go round the different grocers' shops in London, and report how many species of vessels they could find with apertures shot in the same way as those barrels.

TO BE CONCLUDED IN OUR NEXT.

Court of Chancery.

IN the Report of the proceedings in the Court of Chancery in our last Number, which we copied from a daily paper, (the accuracy of which in such matters is generally to be relied on,) it was stated, as the remark of the Lord Chancellor, "*that in the present reign about* 20,000 *patents had been granted for inventions.*" This, on farther consideration, appeared to us so improbable as to induce us to ascertain the fact, by actual reference to the proper sources of information, and we find that in this reign, up to the year 1816, the number of patents granted for inventions is 3256; a very important number, though differing widely from our late Report. The error must be attributed to the press, for it is not possible the Lord Chancellor could have been so mistaken. We subjoin a list, to shew the grants in each reign of this kind from Charles the Second to the present year; by which it appears, that since the publication of these inventions in the Repertory of Arts, which commenced in June 1794, and which are not published in any other work, the number of them has prodigiously increased — a pretty good proof of the beneficial tendency of this publication; though it has often been represented in a contrary light, and for private views, even before Committees of Parliament.

Patents granted from 1675 *to* 1816.

1676 to 1685, inclusive, being the last ten years of Charles II.	46
1686 to 1689, James II.	13
1689 to 1702, William and Mary	102
1701 to 1714, Anne	30

1715 to 1727,	George I.		95
1727 to 1760,	George II.	thirty-three years	258
1761 to 1770,	George III.	ten years	215
—— to 1780,	————	ditto	299
—— to 1790,	————	ditto	556
—— to 1800,	————	ditto	692
—— to 1810,	————	ditto	943
—— to 1815,	————	five years	551

List of Patents for Inventions, &c.

(Continued from Page 254.)

JOHN BARTON, of Silver-street, in the city of London, Civil Engineer; for certain improvements in pistols. Dated August 31, 1816.

ERRATUM.

In our last Number, Page 244, line 20, *for* muriatic acid *read* sulphuric acid.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. CLXXIV. SECOND SERIES. Nov. 1816.

Specification of the Patent granted to John George Druke, *of Chapman-street, Pentonville, in the County of Middlesex, Chemist; for a certain Method of expelling the Molasses or Syrup out of refined Sugars, in a shorter Period than is at present practised by means of Clay* *.

Dated February 3, 1816.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said John George Druke do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained as follows; that is to say:

Firstly. The whole of the articles or ingredients herein and following, named, described, or referred to, come within the meaning and intent of my invention, *viz.* sulphates of lime, natural and artificial, combinations of calcareous earths, with suitable acids or other fit substances, and, in fact, all articles or ingredients which have calcareous earths in their composition or for their basis, and which it is not necessary to mention specifically; the same and the manner to compound them being well known. And I do declare the same may be used with more or less advantage for the purpose, and in the manner herein following named and described, either separately or together, or in conjunction with other earths or fit substances, provided the same are mixed with a requisite proportion of fluid, or moistened to the preferred consistency herein following described. I, however, prefer the use of the natural sulphate of lime, calcined and powdered, and commonly called plaster of Paris, which is already an article of commerce.

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* The patent was granted for a new-invented process or improved method for expelling the molasses from sugars, particularly refined sugars, in a shorter time than the same object is effected by means of clay.

As the best medium, I put three parts of any fit liquid (by preference cold water) into a convenient vessel: I then add thereunto one part of plaster of Paris, or, in other words, I prefer having the proportions in the ratio of one pound weight of plaster of Paris to three pints of water. When, by sufficient stirring and attention, the said proportions are well united, I suffer the mixture thus produced to stand an hour or longer, stirring it occasionally. If the said mixture or mass so formed possesses the prepared consistency hereafter more particularly described, I force it, if required, through a perforated machine, (preferring one of the same construction as used by sugar-refiners in separating the finer from the coarser clay,) for the purpose of separating the finer from the coarser part of the said mass. As soon as it has been forced through the said machine it is ready for application; and I then term it the operating mass or substance. The said mass, however, as the foregoing implies, may be formed without the assistance of any perforated machine;

chine; I use one only, because I prefer having the mass fine. But as the plaster of Paris, on account of its different degrees of calcination, being one time more and another less burnt, requires corresponding quantities of fluid; should the proportion of one part plaster of Paris to three parts water make the mass or mixture too stiff for application, in such case I add by degrees, and under diligent stirring, so much more water as may be wanted. But should the said mass or substance, on the contrary, prove too much diluted, I add, cautiously, so much more of plaster of Paris as may be required to obtain the proper consistency. Finally, I force the same, if required, as before, through the perforated machine. Though the aforesaid mass or mixture may be formed in different ways and by different means, and the proportions varied, I prefer this before-described method as being most convenient.

To ascertain the preferred consistency of the operating mass or mixture I proceed in manner following. When the said mass or mixture has the appearance of paste, or nearly so, I dip my finger into it, to the depth of one or two inches below the surface, and draw my said finger along. If the preferred consistency be obtained, the impression or channel caused by my finger will remain, or not be closed up readily. But, to be more clearly understood, I prefer to have and to use the said operating mass or substance, of the same consistency, or nearly so, as well-prepared clay. And I make with the said operating mass or substance the same allowance, and use the same precautions, as are commonly observed in the use of clay. In fine, all rules observed in the use of clay I likewise observe and adopt in respect to the aforesaid operating mass or mixture, and which are too well known to render needful a particular description. The operating mass or substance being thus properly prepared, terminates this part of the process.

The different sugars being placed in the moulds, according to the common process; I suffer, in preference, (as is usually done,) the syrup or molasses to drain therefrom. The surface of the sugars by this operation becoming unequal or irregular, I proceed to make the same uniform or even; for which purpose I prefer the means at present in use, and too well known to require particular description. I place upon the wider part of the mould or moulds, in other words between the sugars and the operating mass, any convenient substance or substances, of a texture or composition proper to admit the moisture from the operating mass to drain through the said substance or substances, and for which purpose I prefer a piece or pieces of calico, and, for the sake of distinction, denominate the same the intermediate substance or substances. I then fill upon the said intermediate substance or substances a certain quantity of the operating mass or mixture to the depth of two or three inches, more or less, as required. It is adviseable to have the aforesaid piece or pieces of calico, or intermediate substance, somewhat larger than the circumference of the upper or wider part of the mould; also that the said calico or intermediate substance should not be suffered to hang over the sides of the mould, but be carefully turned up at the edge. I may further add, that I prefer damping the calico or intermediate substance previous to its receiving the operating mass. I am also careful in observing that the said operating mass rests in an uniform thickness on every part of the sugars.

Although I alluded particularly in the foregoing to moulds, the operating mass and intermediate substance before described may be applied with equal utility and success to sugars, in whatever vessels or receptacles they may be placed, for the purpose of being separated from the molasses. It is, moreover, always advisable that the intermediate substance should be of the same shape, and larger than the vessel or receptacle on which it is placed.

I suffer the operating mass to remain upon the sugars until the said mass or substance becomes stiff or hard, or no longer capable of imparting material moisture, which operation generally requires in rooms of moderate temperature forty-eight hours. I then remove the mass from the sugars, and make the altered appearance of the surface again uniform, (should such a procedure be required,) in the customary manner. I afterwards replace (as before) either a fresh quantity of the operating mass, or the same which I had previously used, supplying to it an additional degree of moisture to form it again of a proper consistency. I continue this operation of placing and replacing the operating mass or masses upon the sugars until the same are neat; which end I generally attain with small loaves in eight or ten days, and with larger ones, lumps, and masses, in a proportionate time. When the sugars are neat I proceed to drying the same in the usual manner. It may be remarked, that to make small loaves neat two or three applications are sufficient.

Although I prefer the removal of the operating mass or substance from the sugars when it can no longer impart material moisture, or when it appears so stiff or hard, as before stated, yet the said mass or masses may be continued for a longer or a shorter period if required, as this may depend upon the option of the refiner. Loaves of a large size, lumps, and masses, of course require corresponding quantities of the operating mass, as well as a proportionate time for the completion of the process.

Although my operating mass may be applied to sugars without the aid of any intermediate substance or substances, yet I consider the said intermediate substance or substances, on account of the great benefit derived from it or them, in removing the mass or masses, and preventing the sugars from being soiled and wasted, as forming a very essential part of my invention and process; and I claim it as such, whether it is used (for the purpose herein specified) with my aforesaid operating mass, or with clay, or with any other substance or ingredients whatever.

Having thus described, as fully and as explicitly as is required, and as the nature of my invention and improved process will permit, the necessary particulars and manner thereof, I do declare, that this my said invention, and improved process, may be carried into effect and practice either in its whole or separate parts and proceedings, without conjunction or in conjunction with other methods or apparatus already in use; and that the management thereof, the several proportions of materials or ingredients, the vessels or apparatus to be used, and the needful attentions to local and other circumstances, are all susceptible of variation, according to the exigencies of the respective works and operations; but that the same may be well understood from the instructions contained in these presents by any competent workman, or other person or persons acquainted with the general course and nature of chemical operations.

In witness whereof, &c.

Specification of the Patent granted to Robert Kemp, *Junior, of Cork, Smith and Brass-founder; for an Improvement or Improvements in the making or manufacturing of Locks and Keys.* Dated May 27, 1816.

With a Plate.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said Robert Kemp do hereby declare, that my said invention of improvements in the making or manufacturing of locks and keys, is described and ascertained in manner following; that is to say: My improvement in the making or manufacturing of locks consists in applying to the interior part of the lock certain sliders or tumblers, in such manner that when the bolt of the lock is shut or locked, certain parts of the said sliders shall be in contact with, and intercept, some projecting part of the bolt; and the said sliders being incapable of motion, except in a direction at right angles to the direction of the motion of the bolt, they will prevent the bolt being drawn back so as to unbolt the lock. Before the lock can be unbolted, each of the aforesaid sliders must, by the application of the key, be moved a certain quantity, in a direction perpendicular to the direction in which the bolt moves; which quantity must be such as will put the sliders into a position in which those parts of them which were in contact with, and which intercepted the projecting part of the bolt, will correspond with certain notches cut through the said projecting part of the bolt. Thus the contact will be destroyed, and the sliders will no longer intercept the motion of the bolt, but leave it at liberty to be thrown back by the action of the key, in the usual manner of other locks. The motions of the said sliders are all independent of each other, and the said notches in the projecting part of the bolt are made exactly of the size to correspond with the parts of the sliders which are to pass through them; therefore each one of the sliders must be moved precisely to its required position, and neither more or less, or it will not correspond with the notch belonging to it, and cannot suffer the bolt to pass.

But, be it observed, I do not claim the invention of all the different modes of applying such sliders to a lock which can be used, but my improvement is for that particular manner of applying them, which is more minutely described hereinafter, and by the drawings hereunto annexed; and also for the particular manner of communicating the requisite movement to the said sliders, which is by perforating the centre pin upon which the key turns round when it is inserted into the lock, in order to lock or unlock the same, so that the said centre pin is a hollow tube. And I apply, within the perforation or hollow of the tube, pins, which operate upon one of the aforesaid sliders, so that by pushing back the said pins in the tube or hollow of the centre pin it will give motion to the sliders. And as two, three, or more independent sliders are used in the lock, as many different pins must be inserted in the hollow or centre pin of the lock, to correspond with them. The pin which communicates motion to the first slider, or that which is nearest the key-hole, may be perforated in the manner of a tube, to admit the pin for the second slider to pass through it; and the pin for the second slider may in like manner be perforated like a tube, for the pin of the third slider to pass through, and so on for as many sliders as are adapted to the lock; and the greater the number of these, the greater will be the security of the lock; because the sliders being each independent of the other, any one which is not placed in its proper position will lock the bolt fast equally with the whole number.

But be it observed, that I do not make claim to the invention of a hollow centre pin for a lock, or of a pin to be applied within the said hollow, for the purpose of communicating motion to certain parts within the lock. But my improvement consists in that particular manner of applying several different pins, one through the other, which is hereinafter explained, and which are for the purpose of actuating or giving motion to that particular kind of sliders herein explained.

Also my improvement in the making or manufacturing of keys consists in applying within the pipe of the key (or that hollow tube which is to receive the centre pin of the lock when the key is introduced into the lock) a pin, which shall enter into the hollow or tube of the centre pin, and press upon the end of the pin before described, which actuates the slides that detain the bolt; and this pin, within the pipe of the key, being made of determinate length, will depress or push back the pins and slides to the required positions, when each one will correspond with the notch which is cut for it in the projecting part of the bolt. Also, if there are two, three, or more sliders employed, the pin in the bottom of the pipe of the key must be provided with as many different shoulders or steps as will correspond with each of the pins or tubes of the sliders which are contained in the hollow centre pin of the lock; and each of the said shoulders or steps must be adapted in length or projection to produce that quantity of motion in each slider which it will require to make it correspond with the notches in the projecting part of the bolt.

These are the particulars of my said invention; and to

shew

shew the manner of their application to a lock, I have hereunto annexed drawings; in which Fig. 1 (Plate XI.) is a plan of a lock, and Fig. 2 an elevation corresponding therewith. Fig. 3 a section to shew how the key operates upon the sliders and bolt; and Fig. 4 is a perspective view of so much of the lock as will explain my invention. In all, the same figures and the same characters of reference denote the same parts: and those parts which are marked with numbers are of my invention; whilst the letters of the alphabet are placed upon those parts which are common to other locks, and which are not parts of my invention, but are necessary to be described in order fully to explain the manner of carrying my said improvements into effect. A C is the bolt of the lock, guided by the square staple B, which is screwed down to the plate P P P P, at the other end of the bolt; it is guided by a piece of metal K, fixed to the plate P, and a notch in the returned part of the bolt fits upon K. The dotted lines D represent the tumbler of the lock, and E its spring; F the projecting part of the tumbler, which enters into the groove or opening R N O cut in the bolt, and when the tumbler is down, so that the projection F rests in either of the notches R or O, or when the tumbler is raised up, so that the part F enters the notch N. In either of these cases the bolt cannot be moved, therefore the bit or part L, Fig. 3, of the key must be made of that exact length which will raise the tumbler into the position of Fig. 1, where the projection F is seen in the groove between R and N O, and neither more or less than that position, or it will not allow the bolt to move. X is the circular box or case, in which the bit of the key turns round upon its centre pin; which centre pin is fastened to the cover plate of the said box, and projects through the plate P P, as shewn in Fig. 3, at X. G is a tube, a tube, fixed fast to the plate P, and forming an external sheath for the reception of the shank of the key, which tends to guide it as it turns round. The action of this lock is, that by introducing the key S L H into the tube G, and with the centre pin of the lock up the pipe of the key, and turning the key round upon its centre pin, the part L of its bit will act upon the tumbler D, and raise it to the position of Fig. 1, which will set the bolt at liberty to move; and this being done, by turning the key farther the part H of the bit will enter a notch or talon of the bolt, and will move the bolt either to lock or unlock it, according to the direction in which the key is turned. This is the description of the common tumbler lock, and to the invention of which I make no claim.

But my improvements on the making or manufacturing such locks is to apply the projecting piece of metal 20 to the bolt A C, and two sliders 1 and 2, to slide upon the pins 3 3, which are firmly fixed into the plate X, and are supported by being received at the other ends into the external plate of the box of the lock. 4 and 5 are the notches cut through the projecting piece 20, and the sliders 1 and 2 must be brought exactly opposite these notches before the bolt can move. The requisite movement is given to the sliders 1 and 2 by pins, which are conducted through the centre pin *x* of the lock, which is made hollow, like a tube, for that purpose, and the pin which is attached to the slider 2 (and marked 6, Fig. 4, and seen also in Fig. 3,) is perforated, or made hollow, to admit the pin 7, which is affixed to the other slider 1; and if there was a third slider above 1, the pin 7 must be made hollow, to admit a pin from it, in the same manner as the pin 7 passes through 6. The sliders 1 and 2 have always a tendency to approach the plate X by the constant pressure of the springs 10 and 11, which apply separately to each, and press them down in the absence of the key, so that they will not correspond with either of the notches in the projecting piece 20.

And my improvement in the making or manufacturing of the key consists in applying at the bottom of the tube or pipe of the key a short pin 8, which, when the key is put into its place, as in Fig. 4, shall enter into the hollow of the centre pin, and press upon the end of the pin 7 of the slider 1, and move that slider into a position to correspond with the notch 4, as shewn in Fig. 3. Also at the side of the pin 8 is a small projection or step 9, which is adapted to act upon the end of the tube 6 of the other slider 2, and thus move it into the position to correspond with the notch 5.

The explanation of the action of these improvements is scarcely necessary after what I have said. Fig. 3 shews the whole action, by which the pin 8 and step 9 press upon the pins 7 and 6, and put the sliders 1 and 2 into their required positions. To prevent the pins 6 and 7, within the hollow centre pin, from being deranged or examined, I cover the end of the said hollow centre pin by a piece of metal, having a small hole in it, shaped like *x*, Fig. 5, which admits the pin 8 in the pipe of the key to enter, and also the projecting step 9; but when the key is pushed back into its place, as in Fig. 3, it can be turned round on its centre pin to open the lock. The springs 10 and 11 are shewn as if they were supported at the top of the pillars 12 13 at one end, and the opposite ends bear upon the sliders 1 and 2; but it is not essential that the spring should be of this kind; spiral springs, or any other kind, may be used as are found most convenient. Also, for the sliders themselves, they may be guided in their motion by applying a pin or guide at each side of each slider, instead of one pin through the middle of the slider, as at 3, 3, but such manner of guiding them must be used as will prevent them from moving in any other direction than in the direction perpendicular to the motion of the bolt.

With respect to the manner of making the key of my said lock, it may be made in two pieces, first, the bow or handle, and the pin within the pipe, by which the sliders are moved, and the tube or pipe of the key and its bit are made in a separate piece, and screwed together, that is by forming the part of the handle just below the pin into a screw, which enters a female screw, cut within side the tube or pipe at its upper end; and when the pins and projections are made of the exact length to push back the sliders to the proper place, the two parts of the key may be screwed fast together; and, farther, to secure them from any deviation, may be soldered fast.

In witness whereof, &c.

OBSERVATIONS BY THE PATENTEE.

I have thought proper to call this lock the Union Lock, from the circumstance, that it unites the good qualities of two of the most approved locks at present in use, *viz.* those invented by Mr. Bramah and Mr. Barron. From the manner in which the combination of their principles is effected the union lock affords a greater degree of security than either of the former, or than both of them together, supposing a lock of each kind was placed on the same door.

The desirable properties in a lock are,

1st. Strength to resist violence in forcing back the bolt.

2d. Security against being picked or opened by picklocks and skeleton keys.

3d. That every possible difficulty be offered to making a false key from impressions taken from the lock or from the real key. And

4th. That its construction be not complicated so as to render it liable to accidental derangement.

The Patentee presumes the union lock will on examination be found to possess all these requisites in a high degree. To give it strength, it is provided with two, three, or more independent tumblers, which must be broken before the bolt can be forced back by violence; by these parts alone it has all the strength of Barron's lock, which has hitherto been considered the strongest lock which could be made. But the union lock, in addition to the tumblers, has two or more sliders, which intercept the projecting part of the bolt, and these sliders have far more strength to resist the forcing back of the bolt than all the mechanism of Bramah's lock.

In respect to security against pick-locks, both Barron's and Bramah's locks are justly considered as very secure, but the union lock must be allowed to be much more so. There will be all the difficulty of raising each of the tumblers independently to their exact position, and neither more or less; and suppose this can be accomplished, there remain the difficulties of depressing the new-invented sliders each to its exact position, and neither more or less.

The instrument and manner of making trials to raise the tumbler is very different from that which must be used to depress the sliders, and both these operations must be performed at the same time, or the lock cannot be opened. The union lock on this account affords a greater degree of security, from the increased number of its combinations, than if a lock of Barron's and another of Bramah's were placed on the same door.

Each lock would then present a series of difficulties of very different natures; but in the union lock all the same difficulties must be encountered at once.

The security against making a false key is a great advantage in the union lock, and it is the point in which locks in general have hitherto been most defective. An impression from which a very expert workman may possibly make a false key can be taken in a moment in wax or soap from Barron's key, and from Bramah's is still more easy; but in the union key this is exceedingly difficult. The steps at the bottom of the pipe are so securely guarded from inspection, that no common means of taking impressions will give any knowledge of them; and if this could be obtained, some means must be found to make them correspond with the bit of the key, both in number and distance. A dishonest servant, who does not possess any particular ingenuity, may be instructed by a locksmith how to take the requisite impressions of either Bramah's or Barron's keys, even if he is only entrusted with them for a few minutes; this cannot be done with the key of the union lock; it would require the locksmith to examine it himself, and make several tools to ascertain its different dimensions, which he could not do without having it in his possession some considerable time, with leisure to make repeated trials. And though the Patentee does not mean to assert, that a false key could not be made by a very accurate and skilful workman from a full examination of the real key, yet he thinks it will be allowed to be a very difficult undertaking, and to do it from impression alone absolutely impracticable.

The structure of the union lock is not complicated; and all the parts having a proper degree of strength, they are not liable to derangement: besides, with all its advantages, it is a lock of very moderate price.

Specification of the Patent granted to the Reverend WILLIAM MILTON, *of Heckfield, Hants; for certain Improvements upon the Wheels and Perches of Carriages.*

Dated February 10, 1816.

With an Engraving.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said William Milton do hereby declare that the nature of my said invention, and in what manner the same is to be performed, are particularly described and ascertained in and by the drawings hereunto annexed, and the following references thereto, or description thereof; that is to say: My said improvements consist in making the lock of a four-wheel carriage as practicable with wheels, however high before, as it is with the low wheels, now commonly used; and in making such high wheels more capable of enduring violent shocks than by the present mode of making they would be.

The lock with high wheels before is thus affected:

a b e d, Fig. 1, (Plate XI.) is the hind body of a waggon, of a stage coach, or of a gentleman's family travelling carriage, or other carriages up-borne by its wheels on the ground at G. To the top and along the middle of this hind body is fixed the upper perch *a b c* to the bottom, the under perch *d e f c* and *f* being in the central and vertical line of the intended lock motion. Thus circumstanced, this hind body will fall backwards or forwards, according as the front of it, *b e*, is heavier or lighter than the back *a d*. To prevent this falling, insert at and between *c f* the figure *m h k*, representing a fore body on its wheels, provided with top and bottom pins *s s*, and with proper keys, or with a perch bolt, going all the way through

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Mr. Kemp's Patent.

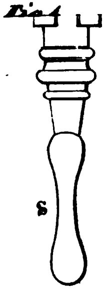


Fig. 4

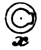
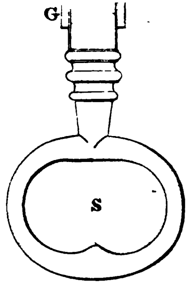


Fig. 5.



Revd. Mr. Milton's Patent.

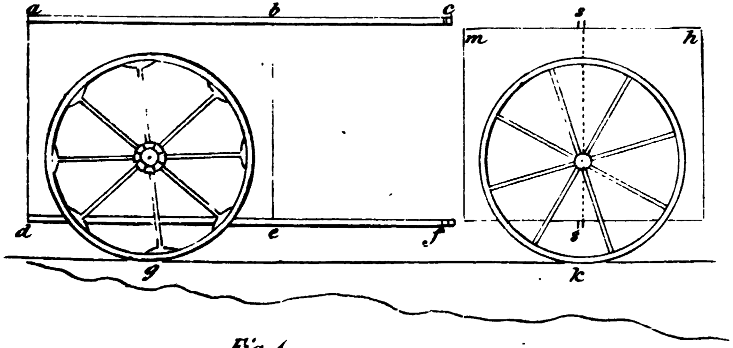


Fig. 1.

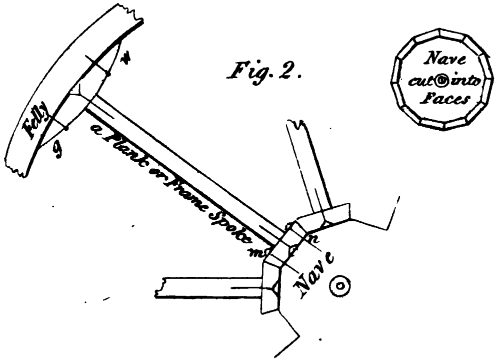


Fig. 2.

through. This done, both bodies, with little effort, but with full stability, lean against each other, and thus arranged, the fore body, though on wheels as high as those behind, will look freely and completely between the upper and under perches. A sufficient stop or check from the fore body to the upper or under perch, or to both, is to be so placed, as that in locking, the retiring wheel shall never touch either of the perches. The mode of making these high wheels is thus: cut the cylindric nave along its length into as many planes or faces as there are to be spokes; for spokes use planks or frame-work, tapering from the nave to the felloe. The plane of each spoke is to be arranged as parallel as may be to the direction of the axle-arm. At the nave end of these spokes fix on firmly a piece of projecting wood *m n*, (see Fig. 2,) filling the face or plane of the nave, which is to be applied and fixed to. And at the felloe end of these spokes fix on another piece *g w*, so projecting as that it may be fastened to the felloe. These spokes and their nave end pieces will go round and occupy the whole circumference of the nave, and thereby mainly contribute to keep each other well in their places. If the number of spokes be an even number, and their nave-end pieces have longitudinally a faint tapering, and the position of this tapering be alternated, then, on the failure of a spoke, it will be easy, on removing its fastenings, to draw out the broken spoke and to slide in another without disturbing a single felloe.

In witness whereof, &c.

OBSERVATIONS BY THE PATENTEE.

The aim of this invention is, to have the fore wheels as well as the hind AS HIGH as the altitude of the horse's chest, and other circumstances will permit. Supposing *all* the wheels of a double bodied stage-coach, for instance, were seven feet high, these consequences would follow: BELOW the axles there might be boxes of such depth and capacity as to receive ALL *the luggage* which a coach-master could, with any prudence, wish to carry. This would be a change of the greatest mechanical importance, towards that safety which the Legislature has repeatedly sought after, and is still seeking; and the draft of the vehicle, whether stage-coach or waggon, would be bettered, to the saving of ten horses out of every present sixty. The disasters occasioned by luggage piled, as it is, on the roof, are notoriously of such frequency and seriousness as to throw it as a duty on the coach-masters to inform themselves, decisively, whether this saving plan be or be not a practicable thing. The Patentee will be ready, as far as can depend on him, to stand this trial.

Specification of the Patent granted to WILLIAM BAYNHAM, *of London Road, in the County of Surrey, Chemist; for a Composition for making Leather and other Articles Water-proof.* Dated February 20, 1816.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said William Baynham do hereby declare, that the nature of my said invention, and the manner in which the same is to be performed, is particularly described and ascertained by the following description thereof; that is to say: Six gallons of linseed oil, one pound and a half of rosin, and four pounds and a half of red lead, litharge, or any other substance usually known under the denomination of dryers, are to be boiled together till they acquire sufficient consistence to adhere to the finger in strings, when cooled upon a bit of glass or otherwise. It is then to be removed from the fire, and, when sufficiently cooled, thinned to about the consistence of sweet oil with spirits of turpentine, of which it generally takes about six gallons. It is then left to settle for a day or two, when it is carefully poured off from the grounds, and about one pound and a half of ivory or lamp black and one pound and a half of Prussian blue, ground in linseed oil, added to and intimately mixed with it. It is then ready to be used as follows, on any description of leather, cloth, or other articles. Having stirred up the liquid, lay it on with a brush until it bears out with an even gloss, then hang up the subject acted upon until the next day, when repeat the application as before, taking care to leave the surface thin and even as possible, and so on each successive day until it has the desired appearance.

In witness whereof, &c.

On the Fire-Damp of Coal Mines, and on Methods of lighting the Mines so as to prevent its Explosion.

By Sir Humphry Davy, *LL.D. F.R.S. V.P.R.I.*

With a Plate.

(Concluded from Page 286.)

HAVING succeeded in the construction of safe lanterns and lamps, equally portable with common lanterns and lamps, which afforded sufficient light, and which bore motion perfectly well, I submitted them individually to practical tests, by throwing into them explosive atmospheres of fire-damp and air. By the natural action of the flame drawing air through the air canals, from the explosive atmosphere, the light was uniformly extinguished;

guished; and when an explosive mixture was forcibly pressed into the body of the lamp, the explosion was always stopped by the safety apertures, which may be said figuratively to act as a sort of *chemical fire sieves* in separating flame from air. But I was not contented with these trials, and I submitted the safe canals, tubes, and wire gauze fire sieves, to much more severe tests: I made them the medium of communication between a large glass vessel, filled with the strongest explosive mixture of carburetted hydrogen and air, and a bladder two-thirds or half full of the same mixture, both insulated from the atmosphere. By means of wires passing near the stopcock of the glass vessel, I fired the explosive mixture in it by the discharge of a Leyden jar. The bladder always expanded at the moment the explosion was made; a contraction as rapidly took place; and a lambent flame played round the mouths of the safety apertures, open in the glass vessel; but the mixture in the bladder did not explode: and by pressing some of it into the glass vessel, so as to make it replace the foul air, and subjecting it to the electric spark, repeated explosions were produced, proving the perfect security of the safety apertures; even when acted on by a much more powerful explosion than could possibly occur from the introduction of air from the mines.

These experiments held good whatever was the proportions of the explosive mixture, and whatever was the size of the glass vessel, (no one was ever used containing more than a quart,) provided as many as twelve metallic tubes were used of one-seventh of an inch in diameter, and two inches and a half long; or provided the circular metallic canals were one twenty-fifth of an inch in diameter, one one-seventh of an inch deep, and at least two inches in circumference; or provided the wire gauze had apertures of only $\frac{1}{120}$ of an inch. When twelve metallic tubes were employed as the medium of communication, one-seventh of an inch in diameter and an inch long, the explosion was communicated by them into the bladder. Four glass tubes of the one-sixteenth of an inch in diameter and two inches long, did not communicate the explosion; but *one* of this diameter and length produced the effect. The explosion was stopped by a single tube one twenty-eighth * of an inch in diameter, when it was three inches long, but not when it was two inches long.

The explosion was stopped by the metallic gauze of $\frac{1}{120}$ when it was placed between the exploding vessel and the bladder, though it did not present a surface of more than half a square inch, and the explosive mixture in the bladder in passing through it to supply the vacuum produced in the glass vessel, burnt on the surface exposed to the glass vessel for some seconds, producing a murmuring noise.

A circular canal, one twenty-fifth of an inch in diameter, an inch and a half in circumference, and one inch and seven-tenths of an inch deep, communicated explosion; but four concentric canals, of the same depth and diameter, and of which the smallest was two inches in diameter, and separated from each other only by their sides, which were of brass, and about one-fortieth of an inch in thickness, did not suffer the explosion to act through them.

It would appear then, that the smaller the circumference of the canal, that is the nearer it approaches to a tube, the greater must be its depth, or the less its diameter, to render it safe.

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* These results appear at first view contradictory to those mentioned in page 281. But it must be kept in view that the first set of experiments were made in tubes open in the air, and the last in tubes exposed to the whole force of an explosion, and connected only with close vessels filled with explosive mixtures.

I did not perceive any difference in these experiments, when the metals of the apertures were warmed by repeated explosions; it is probable, however, that considerable elevation of temperature would increase the power of the aperture to pass the explosion; but the difference between the temperature of flame, and that marked on our common mercurial scale, is so great, that the addition of a few degrees of heat probably does not diminish perceptibly the cooling power of a metallic surface, with regard to flame.

By diminishing the diameter of the air canals, their power of passing the explosion is so much diminished that their depth and circumference may be brought extremely low. I found that flame would not pass through a canal of the one seventieth of an inch in diameter, when it was one-fourth of an inch deep, and forming a cylinder of only one-fourth of an inch in circumference; and a number of apertures of $\frac{1}{100}$ of an inch are safe when their depth is equal to their diameter. It is evident, from these facts, that metallic doors, or joinings in lamps, may be easily made safe by causing them to project upon and fit closely to parallel metallic surfaces.

Longitudinal air canals of metal may, I find, be employed with the same security as circular canals; and a few pieces of tin-plate, soldered together with wires, to regulate the diameter of the canal, answer the purpose of the feeder, or safe chimney, as well as drawn cylinders of brass.

A candle will burn in a lantern or glass tube made safe with metallic gauze, as well as in the open air; I conceive, however, that oil lamps, in which the wick will always stand at the same height, will be preferred.

But the principle applies to every kind of light, and its entire safety is demonstrated.

When the fire-damp is so mixed with the external atmosphere as to render it explosive, the light in the safe lantern or lamp will be extinguished, and warning will be given to the miners to withdraw from, and to ventilate, that part of the mine.

If it be necessary to be in a part of the mine where the fire-damp is explosive, for the purpose of clearing the workings, taking away pillars of coal, or other objects, the workmen may be lighted by a fire made of charcoal, which burns without flame, or by the steel mill, though this does not afford such entire security from danger as the charcoal fire.

It is probable, that when explosions occur from the sparks from the steel mill, the mixture of the fire-damp is in the proportion required to consume all the oxygene of the air, for it is only in about this proportion that explosive mixtures can be fired by electrical sparks from a common machine.

As the wick may be moved without communication between the air in the safe lantern or lamp and the atmosphere, there is no danger in trimming or feeding them; but they should be lighted in a part of the mine where there is no fire-damp, and by a person charged with the care of the lights: and by these inventions, used with such simple precautions, there is every reason to believe a number of lives will be saved, and much misery prevented. Where candles are employed in the open air in the mines, life is extinguished by the explosion; with the safe lantern or safe lamp the light is only put out, and no other inconvenience will occur.

It does not appear, by what I have learnt from the miners, that breathing an atmosphere containing a certain mixture of fire-damp near or even at the explosive point, is attended with any bad consequences. I ascertained that a bird lived in a mixture of equal parts of fire-damp and air; but he soon began to show symptoms of suffering. I found a slight head ache, produced by breathing for a few minutes an explosive mixture of fire-damp and air: and if merely the health of the miners be considered, the fire-damp ought always to be kept far below the point of its explosive mixture.

Miners sometimes are found alive in a mine after an explosion has taken place: this is easily explained, when it is considered that the inflammation is almost always limited to a particular spot, and that it mixes the residual air with much common air; and supposing one of fire-damp to thirteen of air to be exploded, there will still remain nearly one-third of the original quantity of oxygene in the residual gas; and in some experiments, made sixteen years ago, I found that an animal lived, though with suffering, for a short time, in a gas containing 100 parts of azote, fourteen parts of carbonic acid, and seven parts of oxygene.

EXPLANATION OF THE PLATE.

Fig. 1 (Plate XII.) represents the safe lantern, with its air-feeder and chimney furnished with safety metallic canals. It contains about a quart of air. The sides are of horn or glass, made air-tight by putty or cement. A is the lamp through which the circular air-feeding canals pass: they are three concentric hollow cylinders, distant from each other one twenty-sixth of an inch: the smallest is two inches and a half in circumference; their depth is two inches. B is the chimney, containing four such canals, the smallest two inches in circum-

Pl. XII. Vol. XXIX.

UNIV. OF MICH.

Sir H. Davy's Lamp.

Fig. 1.

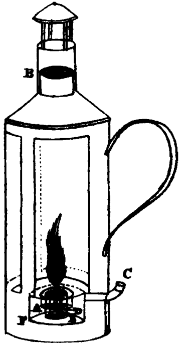


Fig. 2.

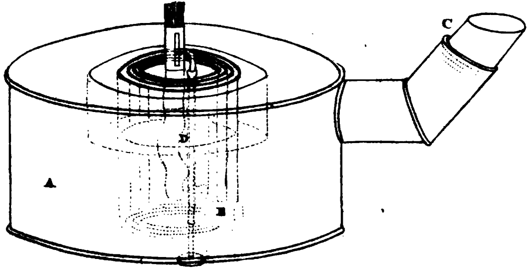


Fig. 3

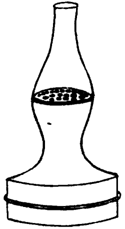


Fig. 4.

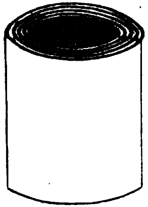


Fig. 5.

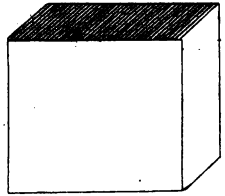


Fig. 6.

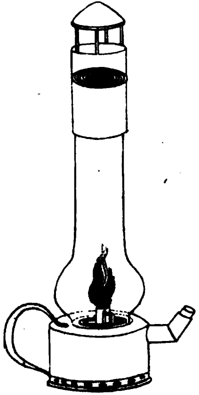


Fig. 7.

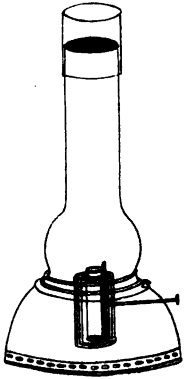


Fig. 8.

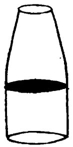


Fig. 11.

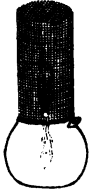


Fig. 9.

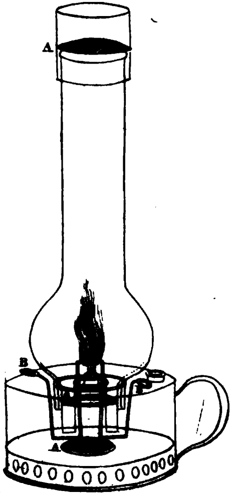
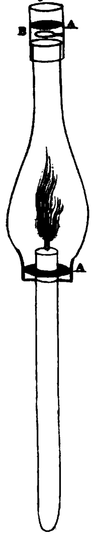


Fig. 10.



circumference: above it is a hollow cylinder, with a cap to prevent dust from passing into the chimney. C is the hole for admitting oil. D is a long canal, containing a wire, by which the wick is moved or trimmed. E is the tube, forming a connection between the reservoir of oil and the chamber that supplies the wick with oil. F is the rim round the bottom of the lantern, to enable it to bear motion.

Fig. 2 is the lamp of Fig. 1, of its natural size; the references to the letters are the same.

Fig. 3 is a common chimney, which may be used in the lantern; but the safety-chimney doubles security.

Fig. 4 exhibits the safety concentric canals of fire sieves, which if one twenty-fifth of an inch in diameter, must not be less than two inches in exterior circumference and 1.7 inch high.

Fig. 5 exhibits the longitudinal safe canals or fire sieves.

Fig. 6 exhibits a safe lamp, having a glass chimney, covered with tin-plate, and the safety apertures in a cylinder, with a covering above: the lower part is the same as in the lantern.

Fig. 7 an Argand lamp, of similar construction, with safe air canals, without the flame, and metallic gauze apertures within.

Fig. 8 a tin-plate chimney-top for the lamp, made safe by metallic gauze.

Fig. 9 a metallic gause safe lamp. A A A screens of metallic gauze, or *flame sieves.* B B wires for trimming the wick.

Fig. 10 a glass tube, furnished with *flame sieves,* in which a common candle may be burnt. A A the flame sieves. B a little plate of metal, to prevent the upper flame sieve from being acted on by the current of hot air.

The lamps burn brighter the higher the chimney.

From my experiments it appears, that a mere narrow throat and opening to the metallic part of the chimney is sufficient to prevent explosions from passing through the lamp, supposing them possible; but with the safety canals or metallic gauze in the chimney the security is absolute.

The circular canals and the apertures covered with metallic gauze are so much superior to tubes in practical application, that I have no doubt of their being generally used; I have therefore given no sketch of the first safe lantern I had constructed with tubes; but substituting tubes for canals it is exactly the same as that represented in Fig. 1.

APPENDIX.

1. In the beginning of my inquiries I had another close lantern made, which may be called the fire-valve lantern. In this the candle or lamp burns with its full quantity of air, admitted from an aperture below, till the air begins to be mixed with fire-damp; when, as the fire-damp increases the flame, a thermometrical spring at the top of the lantern, made of brass and steel, riveted together, and in a curved form, expands, moves a valve in the chimney, diminishes the circulation of air, and extinguishes the flame; but I did not pursue this invention, after I had discovered the properties of the fire-damp, on which the safe lantern is founded.

2. The safety of close lamps or lanterns may probably be likewise secured by sieves made of asbestus, or possibly even hair or silk, placed over the air apertures; but metallic gauze will be necessary above in the chimney. I have little doubt but that windows of fine metallic gauze may be used for giving light in lanterns with perfect security;

curity; perhaps for the chimney it may be worth while to have fine silver-plated wire gauze made.

3. The expansive powers of the fire-damp, during its explosion, are so small as to render no precautions, with respect to the thickness of the glass or horn in the lamps or lanterns, necessary.

An Account of an Invention for giving Light in explosive Mixtures of Fire-damp in Coal Mines, by consuming the Fire-damp.

By Sir HUMPHRY DAVY, *LL.D. F.R.S. V.P.R.I.*

From the PHILOSOPHICAL TRANSACTIONS of the ROYAL SOCIETY of LONDON.

I HAVE already had the honour of communicating to the Royal Society an account of a safe light, which becomes extinguished when introduced into very explosive mixtures of fire-damp; in this communication I shall describe a light, which will burn in any explosive mixture of fire-damp, and the light of which arises from the combustion of the fire-damp itself.

The invention consists in covering or surrounding the flame of a lamp or candle by a wire sieve; the coarsest that I have tried with perfect safety contained 625 apertures in a square inch, and the wire was one-seventieth of an inch in thickness, the finest 6400 apertures in a square inch, and the wire was $\frac{1}{250}$ of an inch in diameter.

When a lighted lamp or candle, screwed into a ring soldered to a cylinder of wire gauze, having no apertures except those of the gauze or safe apertures, is introduced into the most explosive mixture of carburetted hydrogene and air, the cylinder becomes filled with a bright flame, and this flame continues to burn as long as the mixture is explosive. When the carburetted hydrogene is to the air as one to twelve, the flame of the wick appears within the flame of the fire-damp; when the proportion is as high as one to seven the flame of the wick disappears.

When the thickest wires are used in the gauze it becomes strongly red hot, particularly at the top, but yet no explosion takes place. The flame is brighter the larger the apertures of the gauze; and the cylinder of 625 apertures to the square inch gives a most brilliant light in a mixture of one part of gas from the distillation of coal, and seven parts of air; the lower part of the flame is green, the middle purple, and the upper part blue.

I have tried cylinders of 6400 apertures to the square inch, in mixtures of oxygene and carburetted hydrogene, and even in mixtures of oxygene and hydrogene; and though the wire became intensely red hot, yet explosions never took place: the combustion was entirely limited to the interior of the lamp.

In all these experiments there was a noise like that produced by the burning of hydrogene gas in open tubes.

These extraordinary and unexpected results lead to many enquiries respecting the nature and communication of flame; but my object at present is only to point out their application to the use of the collier.

All that he requires to ensure security are small wire cages (Fig. 2 represents this contrivance) to surround his candle or his lamp, which may be made for a few pence, and of which various modifications may be adopted; and the application of this discovery will not only preserve him from the fire-damp, but enable him to apply it to use, and to destroy it at the same time that it gives him an useful light.

Farther

Farther Experiments on the Combustion of explosive Mixtures confined by Wire Gauze; with some Observations on Flame.

By Sir HUMPHRY DAVY, *LL.D. F.R.S. V.P.R.I.*

From the PHILOSOPHICAL TRANSACTIONS of the ROYAL SOCIETY of LONDON.

I HAVE pursued my enquiries respecting the limits of the size of the apertures and of the wire in the metallic gauze, which I have applied to secure the coal miners from the explosions of fire-damp. Gauze made of brass wire, one-fiftieth of an inch in thickness, and containing only ten apertures to the inch, or 100 apertures in the square inch, employed in the usual way as a guard of flame, did not communicate explosion in a mixture of one part of coal gas and twelve parts of air, as long as it was cool, but as soon as the top became hot an explosion took place.

A quick lateral motion likewise enabled it to communicate explosion.

Gauze made of the same wire, containing fourteen apertures to the inch, or 196 to the square inch, did not communicate explosion till it became strongly red hot, when it was no longer safe in explosive mixtures of coal gas; but no motion that could be given to it, by shaking it in a close jar, produced explosion.

Iron wire gauze of one-fortieth, and containing 240 apertures in the square inch, was safe in explosive mixtures of coal gas, till it became strongly red hot at the top.

Iron wire gauze of one-fiftieth, and of twenty-four apertures to the inch, or of 576 to the square inch, appeared safe under all circumstances in explosive mixtures of coal gas. I kept up a continual flame in a cylinder of this kind, eight inches high and two inches in diameter, for a quarter of an hour, varying the proportions of coal gas and air as far as was compatible with their inflammation; the top of the cylinder for some minutes was strongly red hot, but though the mixed gas was passed rapidly through it by pressure from a gasometer and a pair of double bellows, so as to make it a species of blast furnace, yet no explosion took place.

I mentioned in my last communication to the Society, that a flame, confined in a cylinder of very fine wire gauze, did not explode a mixture of oxygene and hydrogene, but that the gases burnt in it with great vivacity. I have repeated this experiment in nearly a pint of the most explosive mixture of the two gases; they burnt violently within the cylinder, but, though the upper part became nearly white hot, yet no explosion was communicated, and it was necessary to withdraw the cylinder to prevent the brass wire from being melted.

These results are best explained by considering the nature of the flame of combustible bodies, which in all cases must be considered as the combustion of an *explosive mixture* of inflammable gas, or vapour and air; for it cannot be regarded as a mere combustion at the surface of contact to the inflammable matter: and the fact is proved by holding a taper or a piece of burning phosphorus within a large flame made by the combustion of alcohol, the flame of the candle or of the phosphorus will appear in the centre of the other flame, proving that there is oxygen even in its interior part.

The heat communicated by flame must depend upon its mass: this is shown by the fact, that the top of a slender cylinder of wire gauze hardly ever becomes dull red in the experiment on an explosive mixture, whilst in a larger cylinder, made of the same material, the central part of the top soon becomes bright red. A large quantity of cold air thrown upon a small flame lowers its heat beyond the explosive point, and in extinguishing a flame by blowing upon it, the effect is probably principally produced by this cause, assisted by a dilution of the explosive mixture.

If a piece of wire gauze sieve is held over a flame of a lamp or of coal gas, it prevents the flame from passing it, and the phenomenon is precisely similar to that exhibited by the wire gauze cylinders; the air passing through is found very hot, for it will convert paper into charcoal; and it is an explosive mixture, for it will inflame if a lighted taper is presented to it, but it is cooled below the explosive point by passing through wires even red hot, and by being mixed with a considerable quantity of air comparatively cold. The real temperature of visible flame is perhaps as high as any we are acquainted with. Mr. Tennant was in the habit of showing an experiment which demonstrates the intensity of its heat. He used to fuse a small filament of platinum in the flame of a common candle; and it is proved by many facts, that a stream of air may be made to render a metallic body white hot, yet not be itself luminous.

A considerable mass of heated metal is required to inflame even coal gas, or the contact of the same mixture with an extensive heated surface. An iron wire of one-twentieth of an inch and eight inches long, red hot, when held perpendicularly in a stream of coal gas, did not inflame it, nor did a short wire of one-sixth of an inch produce the effect held horizontally; but wire of the same size, when six inches of it were red hot, and when it was held perpendicularly in a bottle, containing an explosive mixture, so that heat was successively communicated to portions of the gas, produced its explosion.

A certain degree of mechanical force which rapidly throws portions of cold explosive mixture upon flame, prevents explosions at the point of contact; thus, on pressing an explosive mixture of coal gas from a syringe, or a gum elastic bottle, it burns only at some distance from the aperture from which it is disengaged.

Taking all these circumstances into account, there appears no difficulty in explaining the combustion of explosive mixtures within and not without the cylinders; for a current is established from below upwards, and the hottest part of the cylinder is where the results of combustion, the water, carbonic acid, or azote, which are not inflammable, pass out. The gas which enters is not sufficiently heated on the outside of the wire to be exploded, and as the gases are no where confined there can be no mechanical force pressing currents of flame towards the same point.

It will be needless to enter into further illustrations of the theoretical part of the subject; and I shall conclude this Paper by stating, what I am sure will be gratifying to the Society, that the cylinder lamps have been tried in two of the most dangerous mines near Newcastle, with perfect success; and, from the communications I have had from the collieries, there is every reason to believe that they will be immediately adopted in all the mines in that neighbourhood, where there is any danger from fire-damp.

On enriching the Soil of Gardens by fresh Vegetable Manure.

By the Rev. J. VENABLES, *Rector of Cerne, Dorsetshire.*

From the TRANSACTIONS of the LONDON HORTICULTURAL SOCIETY.

I AM induced to submit to the Society an experiment for the purpose of enriching the soil of a kitchen garden without the aid of animal manure.

The cabbages, cauliflowers, brocoli, potatoes, peas, beans, &c. are planted in my garden, as in most others, in straight rows, or drills. Before the gardener mows the lawn and pleasure-ground he is directed to open a trench between these drills, as wide as the space will admit without injury to the vegetables growing in the rows, and about nine inches in depth. The short grass mown upon the lawn is then carried into the trench, and trodden closely down till it is full, and the earth which had been removed is again thrown upon it, and the ground raked smooth and even.

Every time the lawn and walks are mown the same course is followed till the whole kitchen-garden is regularly and successively enriched with the most excellent vegetable manure. In a very few weeks the short grass buried beneath the surface is decomposed, and incorporates with the earth; and where the peas and beans, and other vegetables are hoed and earthed up, it imparts a very great degree of vigour and luxuriance to their growth.

But it is not the grass only that is converted to this useful purpose. When the potatoes are dug, and the crop of peas and beans gathered, the potatoe haulm, the pea and bean haulm, the outer cabbage leaves and cabbage stalks, in short, the whole vegetable refuse of the garden, to a great amount, is buried in its fresh and green state in the trenches, and far more than repays the nourishment that has been drawn from the ground.

The end of October the asparagus beds are dressed for the winter. The earth, to the depth of about five inches, is first drawn into the alleys; a vegetable coat of manure is then spread over the whole bed; and the earth from the alleys thrown upon the top again. The weeds by this process are effectually destroyed, the bed is enriched, and the plants preserved from the effects of the cold and frost.

My strawberries are also planted in ranks or drills, and in the months of October and November have their narrow intermediate trenches filled with the fallen leaves of the trees, of which there is at that season a very plentiful supply. Few plants profit more by this system than strawberries. From the rapid manner in which they exhaust the vegetable manure in the earth they are observed to require frequently a change of ground, that is, to be removed to a soil where the vegetable manure has not yet been consumed.

I will touch but briefly upon the advantages to be derived from this system.

Mould composed of vegetable substances which have rotted and fermented in a heap till their texture has been broken down, and the greater part of their juices evaporated, is unquestionably of great value, and admirably calculated to impart vigour and strength to the growth of plants. But the vegetable refuse of a garden requires a length of time before it can be brought into this state; some trouble in frequently turning the heaps; and in whatever part of the garden or grounds they are placed, they have always an unsightly and slovenly appearance: add to this, that these heaps lose nine parts out of ten, not only of their size and substance, but also of their most valuable qualities, by the continual action of the sun and air and rain upon them. But if the vegetable refuse of the garden is buried beneath the surface of the ground while fresh and green, it is then easy of solution. The moisture of the earth assists the fermentation and decomposition; and the juices being preserved in the soil, become the nutriment and support of succeeding crops.

When a garden is manured in this way, it is scarcely possible to exhaust the soil. One crop may succeed another during the spring, summer, and autumn; and in the winter the same ground may be fully stocked with every vegetable that will stand the severity of the frost. Each crop will leave behind it sufficient vegetable refuse to keep the soil in constant good condition. To the market-gardeners such a method of cultivation must be of incalculable benefit.

I will only mention one more advantage attending this system, which will strongly recommend it to all those who delight in gardens; I mean its extreme neatness. When the gardener depends upon vegetable matter for the support and improvement of his soil, every weed will be speedily buried in his trenches, and every decayed leaf or withering stalk will immediately be hid beneath the surface of the ground, and converted into a source of fruitfulness and plenty.

On the Processes practised in Germany in manufacturing different Kinds of Glass.

From the ANNALES DES ARTS, &c.

EVERY combination of silex with certain fluxes, producing transparency, has obtained the appellation of glass. The fluxes most generally used are potash, soda, and oxyd of lead. Thus the essential substances in the formation of glass are silex, potash, or soda and oxyd of lead; from the combinations formed with these different materials several kinds of glass are formed, which may be distinguished under four principal classes. The first will comprehend the glass obtained from the combination of one or several earths with salts; this is the light glass. In the second may be ranged the glass produced by the combination of earths with metallic oxyds and salts: this is the dense crystal, which powerfully refracts the rays of light, and is employed with much advantage for spectacles and other optical instruments. The third class is the glass produced by the mixture of earths with metallic oxyds, which is more or less coloured according to the proportion of metal, and more or less transparent according to the nature of the earths that are used in making it. In the fourth class is comprehended the different sorts that proceed from the combination of the earths with each other. This glass can never be of any utility, whatever may be the proportions in which the earthy substances are mixed; it is only coloured when the earths that form part of it are combined with some metal; and it may be easily understood, that the fusibility of the glass is always relative to the quantity of metallic oxyd, or the proportion of alkalies that enter into its composition. One great difficulty in the fabrication

tion of glass is in the preparation of the crucibles, in which it is necessary to melt the materials.

Glass must be brought to a very elevated temperature before it liquifies, and consequently the crucibles must not be fusible at the 140th degree of Wedgwood's pyrometer; indeed, they must be impenetrable by alkalies. In Germany crucibles of all kinds are made with clay; but as clay is a natural mixture of silex and alumine, and as potash and soda have a more decided effect upon silex than upon alumine, as little sand is employed as possible. It is separated with care, so that the clay may contain about 98 parts to 100 of alumine. If the clay contains iron it cannot be used; and if it be mixed with pyrites or sulphate of lime, they must be separated from it, and it must be afterwards reduced to a paste, using certain precautions. The Germans substitute for the sand that is separated from the clay, broken crucibles or well-burnt bricks, which they pulverise and reduce to a fine powder; these substances are mixed with the alumine, because this earth requires more melting than any other, and the burnt clay favours its fusion. The cement of burnt clay being united with the alumine, it is formed into a paste, which they work at several times, and then give it the intended form; the workman is careful to render the paste as little compact as possible, in order that it may resist a sudden change of temperature; when this is done the crucibles are dried in the air, very slowly. When the temperature is below Zero the Germans do not dry them in the open air, lest they should be frozen, for then they would crack or burst in the kiln when they are baking. The dried crucibles are then put into the kiln, to which the temperature given at first is only thirty degrees; it is gradually raised to cherry red, and at last to beyond the usual heat of glass furnaces.

This degree of heat is generally raised in particular furnaces, which are equally destined for the fusion of glass; they are nearly square, divided into three parts, the two ends being more elevated than the middle, which receives the fuel. Although these furnaces are nearly square, the angles are a little rounded, in order that the heat may be more effectually spread and reflected from all parts of the inside; the crucibles are placed in the two divisions at each end of the furnace, that is, on each side of the fuel. In the walls of the furnace, and above the floor on which the crucibles are placed, openings are left for the workmen to put the matter into the crucibles, and to take it out again when it is proper. The furnaces are constructed with an argillaceous infusible paste, or rather bricks very highly burnt. When they are made of an argillaceous paste, it is formed into blocks, which are placed one upon the other, and they are careful to beat this paste well, in order to bind it and give to it compactness and hardness; they continue even to beat the blocks till they think them capable of withstanding the heat of a very violent fire. The kilns being built with the care above described, the materials for making the glass are then to be selected. If glass of the first class is wanted, that is, composed of earths and salts, silex or very pure sand is chosen for the white glass. White quartz, being silex almost pure, is principally employed for the most valuable glass; it is well pulverised before it is used; and to do this with greater facility they calcine it to the degree that will reduce it to a powder. There is no other earth which they use except lime; and this they take either in the state of carbonate, or quick and slaked in the air, and mix it in sand, in various proportions, according to the quality desired, but they mostly prefer quick lime; this earth has the property of giving closeness to the glass, and of rendering it less brittle. Potash and soda are almost the only fluxes used in the glass-houses of Germany; but the substances that are sold in commerce under these names are far from being pure; indeed, they contain the subcarbonates of potash and soda, the soluble salts of these two alkalies, such as the sulphates and muriates, and some soluble substances; it is therefore necessary to purify them. For this purpose they put them in water, and by this means dissolve the salts of potash and soda; they filter and evaporate the solution, and there only remains then the subcarbonates of potash or soda, and a little of the muriates and sulphates.

These purified subcarbonates may be employed with success, and when light glass is to be made they use pure sand and lime, and subcarbonate of potash; it may also be formed by mixing silex with potash and soda. As silex is the only earth that is very vitrifiable, and which gives the transparency to glass, they are careful to reduce it to a very fine powder, because then the glass is much more transparent than it would be if the sand were to be left in coarse grains, the combination with the alkalies being more intimately effected. Silex has this property to so great a degree, that it carries it into all its combinations when they have undergone a certain degree of fire. Thus the greater the quantity of silex the more transparent is the glass. This substance, melted with oxyd of lead or antimony, produces transparent glass, although those metals produce opaque glass, and this is not one of the least remarkable properties of silex; the lime, provided it be not in excess, but only in suitable proportions, gives hardness to the glass without hurting its transparency, which only happens when there is too much lime. All the materials must be very dry when they are used, because the water as it evaporates carries away a proportion of caloric from the surrounding bodies, and may therefore cause the pots to break. In some establishments they even give a sort of fritt, or commencement of fusion, to the materials before they put them into the crucibles, and thus the inconveniences, arising from employing humid materials, are avoided. They calculate, that by employing the materials very dry, a crucible, prepared with care, may melt a hundred times more matter than that which composes it; thus a crucible weighing one pound, may melt a hundred pounds of glass. Although the proportions of lime and silex employed by the Germans in the manufacture of glass are very various, yet it appears, that by taking a mean term, they add scarcely more than from eight to twelve parts of lime to 100 of silex; about these proportions produce glass that withstands tolerably well the vicissitudes of cold and heat, and is not too brittle. If too much lime be put it becomes opaque, because the particles divide, and the least fusible are attached by the lime, which often happens when the glass is left to cool slowly. Lime is, besides, subject to the inconvenience of attacking the alumine of the pots, and by this means renders the glass opaque. The materials for the glass being well dried, they are put into the crucibles, and the heating is commenced; they soon begin to fuse if the fire be continued. If the glass be then made it would be neither homogeneous nor transparent, on account of the number of bubbles of air it would contain. To expel these bubbles, which mostly consist of carbonic acid gas, the matter must be refined, by heating it still more with a very strong fire. The motion that is kept up in the liquified fluid of glass contributes greatly to the refining; and when this is effected the fire is diminished, in order that the glass may be worked. After the fire is diminished the liquid matter is transferred from the crucible into a smaller one; and it is then formed into the desired shapes by manual processes, which, being the same in all countries, there is no occasion to describe them here.

In general the glass is cooled by gradually diminishing the temperature; for if it cool in the air, it frequently becomes extremely brittle. This is proved by the *larmes bataviques*, which break, on being struck, with a great noise, a phenomenon that is easily explained, if we recollect that they are made by throwing a drop of melted glass into cold water, by which the molecules are rendered by no means in equilibrium, the outer parts being cooled so much quicker than the inner; consequently the slightest disturbance of this imperfect equilibrium causes the molecules to separate with violence.

Although the proportions of the materials used in glass-making are not very arbitrary, they vary considerably in different establishments in Germany. Thus, in some they make very good glass with 100 parts of white sand, 6 to 12 parts of lime slaked in the air, 45 to 48 of subcarbonate of soda, and a certain quantity of clippings of glass, which are sometimes equal to the quantity of sand employed. When potash is used as a flux, they are obliged to add a greater quantity, because this alkali melts less sand than soda. The proportions are then, to 100 parts of white sand, from 60 to 65 of subcarbonate of potash, from 6 to 12 of slaked lime, and the quantity of glass chippings vary from 20 to 100 parts. All these proportions give a very good glass. When it is suspected that the materials contain a portion of oxyd of iron, some black oxyd of manganese is added, from 0·20 to 0·25. This oxyd is employed with a view to prevent the glass from being coloured by the oxyd of iron. It is known that oxyd of iron at the minimum gives a green colour to glass, and that at the maximum it gives it a colour more or less yellow. Oxyd of manganese at the maximum gives a violet tint to the matters with which it is combined, and at the minimum it does not colour them at all. If then the iron is oxydated at the minimum, in the materials that compose the glass, the oxyd of manganese by yielding to it its oxygene, will bring this metal to the maximum of oxydation, and will thus change the green shade to a light yellowish tint. The common glass made in Germany is generally composed of 100 parts of sand, mixed with 30 to 35 parts of subcarbonate of potash, and 110 to 130 parts of ashes.

Crystal, which is glass of a greater density, from the quantity of metallic oxyds contained in it, is much manufactured in Germany. It is produced by the combination of sand or silex with the minium (red oxyd of lead) or subcarbonate of lead and the subcarbonate of potash; when instead of the red oxyd of lead the subcarbonate is employed a greater quantity must be put. It is very essential that these substances be well purified; for crystal must be as white and transparent as it is dense. This purification is the more necessary in Germany, as the minium of commerce there is almost always mixed with antimony, zinc, and copper. As lead and potash are both extremely fusible, it is evident that the more there is of these substances in the composition of glass the less fire it will require. In general, the crystal is composed of 100 parts of very pure sand, or white quartz, 80 parts of minium, and 40 of subcarbonate of potash; when the proportion of minium is augmented, that of potash is diminished in the relation equal to what we have described; but in general the minium melts a quantity of sand equal to its weight, while the potash may melt a double quantity. The fine crystal of Bohemia, of Saxony, and Bavaria, weigh hardly more than four or five times more than water; and as litharge is of a density equal to 9·50, it is evident that, if a great quantity be added, it must render the glass extremely dense; the principal difficulty then is, to preserve the glass white and transparent; for an excess of lead always gives a little colour to the glass.

Flint glass, which the English first learned to prepare, is now made in great quantities both in Germany and France, only it has not been made a single branch of industry, because this sort of glass cannot be prepared, but at certain moments, when the melting of crystal is effected. Indeed it would be useless to attempt to make flint glass in a direct way, as they do crystal, for success is never certain; and we must be content to obtain it at the moment when the melted crystal presents a perfect vitrification with an uniform transparency. The Germans prepare their flint glass by combining 100 parts of pure sand or quartz with an equal quantity of minium, 35 to 36 parts of subcarbonate of potash and 10 of nitre. This last introduces but five parts of potash; but the gas that is disengaged has the advantage of assisting to mix the materials, and of rendering their combination more intimate, and consequently the glass more homogeneous. Without this precaution the lead would necessarily fall to the bottom of the vessel, in a tranquil fusion, and the crystals obtained would be of different proportions, which would be a great defect in the glass when used for optical instruments, where the diversity of the refractive force of the different beds or layers would render the sight confused. This inconvenience may likewise be avoided by the addition of one or two parts of arsenic. But the essential point is to mix it well; for without that the glass will be so greatly striated, that it will be of no use for the purpose of making optical glasses.

Crystal glass is made either in covered or uncovered pots, according to the nature of the fuel employed. If it be wood the pots are left uncovered, and 100 parts of sand, 50 or 60 of minium, and 30 or 40 of subcarbonate of potash, are put into them. These fluxes are not employed in the strongest proportions, on account of the degree of heat that is used in this case; but if the fuel be pit-coal the pots are covered, because this fuel emits vapours that would colour the glass; and as the heat is not raised so high, the proportions of minium and subcarbonate of potash are augmented, the first to 80 and 85 parts, and the second to 35 and 45; a little black oxyd of manganese is always added, in order to render less sensible the colour that any metallic oxyd may produce. It is also essential to anneal the crystal after it has been run; for if the crystal be not annealed it will break with the slightest shock, as it will possess very inconsiderable density in proportion to its bulk. This operation is the more necessary, as in general crystal is here made very thick.

The density of crystal and of flint glass is extremely variable, and depends almost solely on the quantity of metallic oxyd that enters into their composition. Ordinary glass weighs about two and a half times more than water, and the density of flint glass varies from three to four; but it is not necessary that flint glass should be very heavy to be employed with advantage in optical instruments, for that which is three times more dense than water produces very good object glasses. But as we have observed before, flint glass is not made at pleasure; it is only when the fusion, &c. of the glass goes on well, that they take out of the middle of the pots the purest beds, the mean density of which may be from three to three and a half greater than that of water. It is only, therefore, when they are making crystal, that they separate the purest and cleanest portions to be used in making optical instruments.

The Germans have besides attempted to substitute for potash and soda the sulphate and muriate of soda; and although the processes they have followed for this purpose have not been so successful as was hoped, they still merit a degree of attention. It is known that the sulphate of soda is indecomposable by the strongest heat; but as silex has a certain affinity for soda, when the sulphate is exposed to a high temperature, after being mixed with the sand, it is decomposed, and the elements of sulphuric acid escape, either in oxygene or in sulphurous acid. The proportions to be adopted are various; thus, in some establishments they succeed with a mixture of 300 parts of sand, 100 of lime, and 100 of sulphate of soda, with five of charcoal, whilst in others a mixture of 100 parts of sand, 60 of sulphate of soda, 20 of lime, and five of charcoal, make glass of a very good quality. They sometimes add burning coals, taken out of the glass furnace, and put into the pots; it must however be observed, that this must be done with great management, as the coal has eminently the property of colouring glass, a property in which it is not surpassed by any of the metallic oxyds. It was even on account of this remarkable property that coal was considered by many chemists as a metallic oxyd, before certain proofs appeared of its being so. This process, which is so difficult to execute, has too few advantages to be generally adopted. The advantages of using this flux are, that much time is gained, and consequently much product from the same furnace and materials. It is essential to observe, that the sulphate of soda without the water of crystallisation dissolves much silex, and thus there is little alkali lost; but this glass has the great inconvenience of being difficult to work, and of devitrifying speedily, like all earthy glass. The Germans have been particularly desirous to employ muriate of soda in glass making, because this substance is very plentiful with them. It is not without great difficulty that it can be used, as the muriatic acid cannot be expelled without water; thus it is very essential to mix it with materials that are a little humid; and even with this precaution there is always a little muriate of soda or of lime left in the glass. The different substances that enter into the composition of glass may be taken in the following proportions: 100 parts of muriate of soda, 140 of sand, and 100 of lime. As muriate of soda bears a very low price there, they make common glass by mixing it with clay a little humid.

We shall conclude these general remarks with an observation on the manner in which glass becomes devitrified. This devitrification of glass, so long misunderstood, and which was remarked in some sort for the first time, with its different phenomena, by M. d'Artigues, is effected in two different ways: 1st. by cooling suddenly, or changing from the liquid state to the paste; 2d. by giving a great degree of fire to glass that has very little flux. When the devitrification is occasioned by sudden cooling, or sudden decrease in the temperature of the mass in fusion, it is produced by the different fusibility and density of the matters that compose the glass, and which separate because they are not all equally fusible. Thus, when glass is melted, in which there is a great quantity of earths, and of heavy and metallic fluxes, if the mass suffer a sudden abatement in its temperature, the materials separate according to the order of their density, and the mass becomes devitrified. Lime is one of the earths that has the most influence in this phenomenon, and that separates the quickest; at the same time remaining combined with the salts that have been used as fluxes. When, on the contrary, this devitrification is effected by subjecting to a high temperature glass that contains but little flux, it manifests itself, not by changing the form of the glass, but by rendering it dense and opaque. Thus, whenever earthy glass is exposed to a very high temperature, a different glass is produced, which is less transparent, and sometimes even so hard that the diamond will not cut it. It would be an object worthy the attention of manufacturers to make this kind of glass, which from its peculiar properties might be employed in numberless ways in the arts. For example, it might be used with great advantage as a substitute for porcelain crucibles, where a great degree of fire is requisite. It has already been used with success in Germany, Italy, and France, for making various ornamental articles, and the impressions of antique cameos that have been obtained on them have the double advantage of being on a material that is almost unalterable from its hardness, and at the same time agreeable to the eye. It appears, therefore, that the heat forms a new compound, in proportions totally different from what they would have been without the high temperature.

The celebrated experiments of Sir James Hall seem to prove it, since the same substance, as basaltes and compact carbonated lime, after being exposed to violent heat and sudden cooling, afforded him a species of glass; whereas when slowly cooled, and submitted to a certain pressure, they produced compounds purely earthy.

On the Preparation of Mortar and Cement.

(Concluded from Page 309.)

THE Germans also take several other precautions in the preparation of mortar, which it may be useful to describe; for instance, they do not put a superabundance of water, because, as the lime only is soluble by it, and as the water occupies much space, and evaporates afterwards, it would leave great interstices, and consequently the continuity would be destroyed. They pay the more attention to it, as, in their cold country, the frost greatly injures buildings constructed with mortar that has been made with more than sufficient water; they are also very careful to beat well together the different substances of which the mortar is composed, in order to render their combination as complete as possible; and they always place the sand above the lime before they beat the whole together. In all their rubble work they use mortar composed of sand, pozzolane or cement, and pounded bricks mixed in thirds or sixth portions to one of lime. This composition, which is excellent for all purposes of building, becomes, with rubble, by means of the pressure of the stones, very solid; and when they use it to form artificial stone, they are very careful to put as little water as possible, for the reasons already given. In short, experience has shewn them, that mortar to be good must be very strongly beaten together, in order that the molecules of lime may be well amalgamated with the sand; and, in the second place, that it must not retain too much water, because in that case the materials cannot unite, or, if they should, they crystallise in a confused manner.

In other parts of Germany they follow a process differing a little from the above described. They take lime newly burnt, as well as pure sand, rough to the touch. Upon a platform or paved floor they form a sort of reservoir, into which they throw a measure of lime, which is covered with sand, in order that the rising vapour may not escape. This first effervescence lasts five or six minutes; and, as it is very strong, all the avenues by which the vapour might escape are carefully closed with sand. Sometimes the crevices, which form suddenly in the sand, multiply to such a degree, that a single hand is scarcely sufficient to stop them immediately; but a quarter of an hour after the lime has been covered, it may be mixed with the other materials of which the mortar is composed.

To render this operation more expeditious and easy, they make the mixture dry. Two workmen spread the heap upon the pavement with their shovels, and form it into a bed of about half an inch thick, in order to reduce more easily to a powder the lime which is not sufficiently divided in the heap under the sand; they afterwards mix the lime with the sand by turning and beating it several times with great force until the mixture is perfect. They then moisten the mixture by sprinkling, or with a watering pot, till it has received the quantity of water necessary to form a rich mortar; the water is then poured on at several times, while the men with their beaters knock the mortar about for ten or twelve minutes. The heap usually contains two cubic feet of sand and one of lime: these proportions depend upon circumstances, for evidently the heap may be more or less large, and consequently require less beating in proportion. As it takes about a quarter of an hour for the lime that is smothered under the sand to be reduced to powder, they prepare several heaps at once, and by the time a third is formed the mixture of the first may be commenced. While the mortar of the first heap is still warm, a labourer carries it to the masons, who employ it without using any more water to it. If the mortar thus prepared should harden, they are particularly careful not to put water to it, for the same effect would follow as if they were to put water to it a second time after it has been beaten up. The workmen in using it render it plastic again by incorporating it, a little at a time, with new mortar. Frequently after having amalgamated and beaten up the materials with water, they add a small portion of cream of lime, about a fifth or sixth proportion, and in this manner they obtain a mortar that is richer and more easy to beat up. This mortar acquires considerable adhesion, and in a very short time. They have besides observed, that this addition of cream of lime, which is nothing more than limestones slaked in the usual way, in a small reservoir, where it is reduced to a cream, always produces a good effect. Mortar to which quick lime is added becomes solid immediately, by a consequence of the affinity of this matter for water; an affinity so great, that all the superabundant liquid passes to a concrete state, and the mortar becomes solid. The Germans have likewise remarked, that when they employ sand that is earthy, yellow, pure, and rough to the touch, the lime consumes more of it; they therefore mix two parts of this with one of lime. If, on the contrary, the sand is fine and soft to the touch, the lime consumes less of it, and it is only necessary to mix three parts with one of lime. They follow the same plan with river sand. Builders in the South of Germany are of opinion, that three parts of a pure sand, which is harsh and rough to the touch, mixed with one part of lime, of good quality, and just out of the kiln, will always make good mortar. When the lime is a little the old, they add, with the same materials, two parts of lime to five of sand. This is the mortar they use for common buildings; indeed, all able builders in this country consider it to be very essential to the solidity of mortar, that it should absorb carbonic acid from the atmosphere, because then the lime passes to the state of carbonate, and acquires the solidity of marble. The iron which forms a part of certain mortars is equally useful, in seizing a part of the superabundant water, and passing to the state of oxyd, as in binding it by its own cohesion. Affinity is the first cause of the adhesion of bodies; and in this case there exists no other cause; for there is no chemical affinity, since there is no change of composition.

When the Germans build in damp places they usually mix cement, or other calcined matter, principally pounded bricks, with the sand of which they make their mortar. In order to give it more tenacity, they mix these substances with the sand before they measure them, so that when they are about to make the mortar they take two measures of this mixture and one of lime, which are well mixed together before they beat it, and that with the quantity of water necessary. When they employ cement with the sand in the composition of mortar, they begin by making an exact mixture of it. The proportions of these different matters are very different in different countries. Thus, some mix one part of cement with two of sand, and think it very good mortar; others think they render it better by putting as much cement as sand, while others again succeed by using only one measure of cement and lime to three of sand. In short, whatever proportions they employ they are always careful to work the mortar well, and to put but little water to it, in order that the chemical action of the different materials may take effect upon each other, and that these materials may be at the least distance possible from each other.

When they are short of sand they employ hard stone pounded; but with much greater success they use scoria, dross of iron, and ashes of pit-coal produced by forges. These different matters are mixed with sand in the proportions already described, and before it is measured with the lime. Sometimes they prepare before hand a certain quantity of these mixtures, and they find it advantageous in the more complete saturation of the ingredients; indeed, they render the mortar still better by moistening it with a little cream of lime, and by compressing it afterwards. Experience has taught them, that the best mortar is that which is well compressed, and that contains no superabundant water. It is, besides, essential, that the mortar be not porous, and the reason is easily found. The system of rubble work which is used in different parts is almost entirely founded upon it. It consists of building with stones and mortar in layers one upon the other, and afterwards submitting the whole to a strong pressure, in order to leave the least possible intervals between the parts.

The mortar, denominated stone mortar, is also a species of rubble-work. It is prepared by mixing one measure of lime with three of powdered stone, sifted, and smothering the lime under the powdered stone after having steeped it in water. They afterwards make a dry mixture of it, beating it strongly, and adding to it the water necessary to reduce it to a paste, which may in some degree be cut with a knife.

Before we proceed to speak of the mortar which is known in France by the name of *bétons,* we shall say a few words on the various coloured mortars they employ.

They prepare their black mortar by mixing with it the cinders or ashes of pit-coal. They usually mix two or three parts of these cinders or ashes with one part only of lime. They add to this mortar only as much water as is necessary to form a paste about as solid as the plastic clay. They beat this paste with much force until the beater adheres to it; but when it hardens rather too much they add a little lime water, or merely wet the beater with it. They vary the colour of the mortar by mixing with the before-mentioned black ashes some white stone pulverised; three measures of this hard stone with one of black ashes make a greyish black; if pounded tiles be added instead of the ashes the colour is brown. Iron dross is likewise used in colouring mortar, after it has been carefully passed through a very fine sieve. Finally, whatever colouring substance is employed they never put more than two or three parts to one of lime.

They mostly prepare the white mortar with two measures of white marble, reduced to powder, and one of lime; the whole mixed dry, and moistened afterwards with lime water. This mortar, not reduced to a cream, but to a paste, is beaten up the evening before it is wanted, and it is beaten again the next day when they use it. Before we proceed to the description of the *bétons* we shall remark, that the most intelligent builders in Germany consider that the practice of putting quick lime into the mortar is of no advantage except when the buildings are in damp places, because the dessication not taking place too quickly, the carbonic acid has time to combine with the lime of the mortar. In works in the open air the sudden drying of the mortar takes from it this property, and prevents the carbonic acid from entering into combination with the substances that compose it; the mortar, however, has the appearance of having acquired great hardness on the surface of the wall, but the interior always remains friable, and without consistence. The solidity is only apparent, since it extends no deeper than that species of crust, which after a little time detaches itself from the mass, and by its fall discovers its instability. The solidity of the antient monuments is not solely owing to the great excellence of their mortar, which has been so often repeated, but to the precautionary measures they employed.

Indeed, the goodness of the antient cements does not appear always to be caused by the lime having absorbed carbonic acid from the atmosphere, and being saturated with it; for frequently, and in a great number of these mortars, the lime affords but a small quantity, nearly half of that which might be taken to pass to the state of carbonate, that is to say, from 20 to 22 *per cent.* Besides, when the mortar forms part of a building well incased, it is in such a state of compression, that it is very difficult for it to absorb carbonic acid from the air. In the second place, the lime coming in contact in this combination with the silex, has no longer so much affinity for the carbonic acid. Thus, since pure lime has a great affinity for silex, whilst the carbonate of lime has none, it may be presumed that this interrupted affinity tends rather to destroy the cohesion of mortar than to assist it. Finally, we may believe it to be possible, that the goodness of the antient mortar is solely owing to the care with which they prepared it, by mixing it well, so that no cavities could be left between the molecules into which water could penetrate.

The *bêtons*, known in Germany by the name of *mortel in den grund legen*, is a mortar which has the property of consolidating in water, and is consequently preferred, and almost solely used, in hydraulic structures. The manner of preparing it in Germany varies so much in different provinces, that we shall only describe those which experience has shewn to be the best. Generally speaking, mortar made with sand, rich or poor lime alone, never composes a *béton*. Pozzolane or burnt substances, and poor lime, must always be employed for that purpose.

In several parts of Germany they obtain a tolerably good *béton* by mixing twelve parts of pozzolane, either natural or artificial, six of pure sand, nine of poor lime, newly slaked, and rubble or cuttings of stone, in proportions varying from six to sixteen parts. They mix it well, for a long time, adding a little water. It is then left to amalgamate for a few hours; when they judge that the combination is effected they run it into the water by means of cones, made for the purpose, and it becomes solid after a little time. They are very careful to employ only poor lime, for rich lime never makes good *béton*. The inhabitants of the coasts having discovered that sea water is more favourable to the consolidation of *béton* than river water, some builders have sought to obtain the same advantage by adding salt to the composition. This auxiliary appears to have been tolerably successful; in other places, and principally in the South of Germany, they prepare *béton* by mixing one part of pozzolane with three of sand and two of poor lime; they run this into cassoons, made for the purpose, and so disposed that the *béton* cannot be too much worked before it acquires a suitable solidity. They are likewise careful to press it well, which is very essential to render it hard. The cement prepared with the residuum of aqua fortis is thought to acquire in three weeks the solidity that a cement made with pozzolane does not acquire in less than three months.

Béton hardens much quicker in water than in the air, owing to the poor lime contained in it, which has the property of consolidating immediately, and almost as quick as the plaster. Indeed the plaster only acquires solidity from the water it takes up, and which it consolidates. As to the stucco manufactured in Germany, and in which they employ, as we do, plaster slaked in water, in which glue has been dissolved; they incorporate with it different substances and colours, according to the effect they desire to obtain. They likewise prepare a good stucco with lime, sand, and the caseous part of milk.

The mastics that are most in use are composed of ninety or a hundred parts of burnt earth or pounded brick, or rather of old brown stone ware, that has served to enclose porcelain or other earthen ware, or rather old crucibles. This matter, pounded with care, is afterwards mixed with eight or ten parts of litharge and the quantity of linseed oil necessary to give to the mastic the suitable consistence. They wet the surface to which the mastic is to be applied; after which they smooth and spread it into the cavities and pores that require to be filled. This mortar, which is used for conduit pipes and for covering terraces, is very solid, and almost impermeable to water. We may observe, by the way, a circumstance rather remarkable, that the same mortar has been employed in the South of France for centuries, and always with certain success. In some parts of Germany they also compose a mastic of a mixture of very pure quick lime with fresh cheese, which we call *pic*. This mastic, which resists an elevated temperature tolerably well, has the property of filling all the pores, and consolidating quickly. The common and vulgar mastic made with quick lime and white of egg has the same properties. Lately, a sort of plaster has been used in the North of Germany, which, though very good for the preservation of monuments, is yet very little known. It is composed by mixing fifty-five or sixty parts of quick lime with twenty or twenty-five parts of burnt plaster, and one part and a half or two parts of white carbonate of lead. To this mixture, well beaten up, is added some fresh cheese, to bind it; the quantity of cheese depends much upon its nature, and the abundance of the caseous part in it; but in general about a fourth of the weight is sufficient. If this plaster does not appear sufficiently solid, they add a little glue or alum, which gives it the proper consistence. Lastly, they make the same sort of plaster with water and Spanish white; but as this is scarcely solid enough in a cold and moist climate, they add a little glue, which enables it to resist the changes of heat and cold.

Court of Chancery, Wednesday July 31, 1816.

(Concluded from Page 318.)

WALKER *v.* CONGREVE.

WHEN the Lord Chancellor entered the Court this morning, this cause, of which we gave the grounds in our last Number, was resumed. Gunpowder barrels of different dimensions, materials, shapes, and apertures were brought into Court on the part of the defendant. Some were made in 1791, some in 1798, and others were made subsequently to the invention of the plaintiff, and under the superintendance of Sir William Congreve. The present defendant, Mr. Walker, likewise brought into Court several of his machines.

Mr. Blenman was heard farther for the plaintiff against dissolving the injunction. He read some documents that had been verified by affidavit as directed, for the purpose of showing that the barrels made at the Royal Laboratory of Woolwich in 1791 were by no means of the same character as those of the plaintiff; and consequently that the objections to the patent arising from the previous existence of models resembling his machines were not well-founded. These documents consisted of three reports made by Sir William Congreve to the Board of Ordnance on the subject of Mr. Walker's barrels. Two of these reports were dated the 11th of August 1810; and one of them bore date August 1811. The report, dated the 11th of August 1810, stated, "that Mr. Walker's copper powder-barrel was by no means so capable of preserving gunpowder for the service of the royal navy as the barrel which was made in the Royal Laboratory in 1791." The report then went over the circumstances in which they differed, and set forth the defects of the patentee's machines in two separate columns, the one detailing the advantages of the barrel of 1791, the other the qualities of Mr. Walker's. The laboratory copper powder-barrel had, he stated, but a *small* aperture, secured by a bung fitted tight, and luted into a conical neck; which neck was covered with a cap of copper, luted also, but which cannot be taken off without using force. Mr. Walker's, it stated, on the other hand, "had a *large* aperture, and the lid and stopper were very imperfect modes to be used in powder-barrels, because, to avoid the use of copper implements, Mr. Walker proposes to have them kicked off with a gunner's foot." "2. The laboratory barrel was intended to preserve *loose* powder in readiness to fill any sort of cartridges, and with such charges as the service required; whereas Mr. Walker's idea of filling copper powder-barrels, at the powder-mills, with gunpowder in cartridges for different natures of ordnance, and with several sorts of charges, would prove impracticable for several reasons; first, because the paper cartridges used in the navy cannot be stowed so close as to allow a sufficient quantitity to be contained in a barrel; secondly, the barrels must be made of different lengths, to admit of cartridges for different natures of ordnance; thirdly, the present examination of gunpowder must be continued; and, fourthly, great confusion would be caused in the store magazines at the out-ports, because of the impossibity of ascertaining what would be the expenditure of different natures of ordnance for a given time. On the other hand, the gunners of ships of war could, without difficulty, examine their gunpowder when stowed in the laboratory's improved copper barrels. Experiments have ascertained that powder made twenty-four years ago, and kept in the *common wooden barrels,* was nearly as powerful as Mr. Parr's new gunpowder, although this last kind was said to contain *oxymuriate of potash* and *fulminating mercury.* The purport of these reports was, that the barrels of Mr. Walker's invention were not so good, so convenient, or so useful, as those which were previously made at the laboratory of the Royal Arsenal at Woolwich; but by drawing this distinction between them the originality of the former was admitted. The report compared barrels of two different shapes and with different properties, and gave as the result of this comparison a preference to the machines formerly in use; but it did not assert that the patentee's were copies of them. In fact, by such a discussion of their comparative merits, with the professed intention of purchasing Mr. Walker's machines, if upon examination they should be found preferable, Mr. Walker's invention was acknowledged to be original. If this were not the case, or if any doubts had existed on the subject, Sir William Congreve would have answered the inquiries of the Board of Ordnance, not by comparing the government machines with machines which, if they should be found preferable, government would be under the necessity of purchasing, but would have considered the public to be equally entitled to both, and would have dissuaded the Ordnance Board from buying what it was already in possession of. That was the time when the originality of the patent should have been questioned; but now it was not to be allowed, that the Ordnance should turn round and say to the patentee, in using your invention we but follow what was made twenty years before you obtained your patent. The navy was now supplied with these machines, and by their use the whole system of preserving powder on board his Majesty's ships was altered. The alteration was in consequence of Mr. Walker's suggestions, and did not spring from the application of knowledge in existence before his invention was made known. If the barrels of Mr. Walker were now thought so useful, and if their consequence was known in 1791, how came it that they were not generally distributed over the navy till 1814, four years after Mr. Walker obtained his patent? The report of the Comptroller of the Royal Laboratory of Woolwich, in August 1810, declared the plan of the plaintiff's barrels impracticable; but now it was contended by the defendant, who held the same official situation, that it had been in practice for twenty-five years.

The Lord Chancellor wished to inspect the two barrels, the plaintiff's and that which was alleged to be a piracy of his patent, as the question he now wished settled was, whether the injunction had been violated. He wished to know facts—he was anxious to ascertain in what the piracy was alleged to consist. Was the machine of the defendant to be considered as a metallic barrel enclosed in one of wood, or merely as a wooden barrel lined with a coating of lead; and did it differ no more, if considered with or without this internal covering of lead, than a tea-chest with or without lining? If the lead was considered as constituting a separate vessel capable of being detached from the wood, there might be some reason to conclude it an imitation.

Mr. Blenman answered, that the lead constituted a separate machine, and that the defendant had not confined himself always to the use of lead, as he had ordered some to be constructed of a stronger metal, copper, which assimilated the two barrels still more.

The Lord Chancellor asked the Counsel of the defendant, if they thought there would be any objection on the part of the government to keep an account of the barrels made till the trial of the validity of the plaintiff's patent by an issue directed to a Court of Law? The public service might thus proceed without interruption, and the plaintiff would have security for his profits, should the decision of law be in his favour.

Mr. Leach believed there could be no objection to this arrangement.

The Lord Chancellor then gave judgement to the following effect.—An *exparte* injunction has been granted in this case, which, if I had considered all the circumstances at the time as anxiously as I have since done, I would have refused till after hearing the adverse party; and I take blame to myself in some respects for not using more caution. The bill upon which this order was obtained stated the invention to be a new invention, and I believe made such a statement with the most honest intention and entire conviction; but the word invention is liable to a very different construction when used by the inventors themselves, and when employed by a Court of Law, after a Jury has ascertained their claims. On the nature of the plaintiff's claims I shall make no observations—on the validity of his patent I will deliver no opinion. It may turn out to be a good patent, or, on the contrary, all claims of originality may be disallowed. I have only to determine at present, whether I ought to have granted the injunction. The bill represents Sir William Congreve as making the barrels in question, not only for the supply of the public service, but for the purposes of sale. The affidavit does not speak of sale, although any one in reading that part of it that refers to the supply of the East India ships with the barrels of the plaintiff, could not but infer that the mention of such a fact was intended to support the allegation of the bill. Had I therefore read the bill and affidavit with strict attention, I think I would not have granted the injunction upon the representation that was made to me; but, after the injunction was made, it should have been observed till the Court dissolved it upon application for that purpose. Knowing, as I do, what belongs to the public service, and speaking with all the respect that I ought of Sir William Congreve's official and individual character, I must tell him what I would tell any other man who is brought as a suitor into this Court, that he must not disobey its orders. He might have moved to dissolve its injunction, but he could claim no right to infringe it. I confess, upon an examination of the two barrels, that I see so much similarity between them, that were the defendant's barrel of copper instead of lead, as it is, it would amount to a violation of the injunction. A violation of an order, however, might be of different kinds, and infer different penalties, according to the intention with which it was committed. It might proceed from a deliberate design to insult the Court, or be accompanied with a consciousness that the authority of the Court was despised or neglected, and would thus be a serious contempt;

tempt; or it might spring from mistake or inadvertence. In the latter case, it became a mere matter of costs. Speaking with all due respect, I will treat Government here as I would any suitor of the Court. Let an account be kept of all the machines made in alleged violation of the plaintiff's patent, subject to the profits to which the plaintiff will be entitled, provided his patent be decided to be a good one. I thus secure to Mr. Walker all that he can wish, or all that he is entitled to obtain. In the mean time let the injunction be dissolved; and let the defendant proceed in supplying the demands of the public service, subject only to account at the instance of the plaintiff on the trial of the legal issue. I would recommend to Government to pay the costs of the present application, as there are grounds for believing the injunction violated. I can only recommend to Government; but by the use of this language I give it to be understood, that if the *recommendation* is not attended to, I will make an *order* for the defendant, Sir William Congreve, to pay the said costs.

List of Patents for Inventions, &c.

(Continued from Page 320.)

CHARLES LACY, of Nottingham, Lace-manufacturer, and JOHN LINDLEY, of Loughborough, Leicestershire, Lace-manufacturer; for machinery to be incorporated with, added to, and used with, parts of certain machines already invented and in use for the making and manufacturing of lace-net, called bobbin or Buckinghamshire lace-net; by the aid of which present invention the said lace net may be made with greater facility and less manual labour than by any machinery or method now in use and known. Dated September 30, 1816.

Jacob Metcalf, of Great Mary-le-bone-street, Middlesex, Brush-manufacturer; for a tapered hair or head brush. Dated September 30, 1816.

Robert Clayton, of Dublin, Artist; for a method of preparing, making, and finishing metal and composition blocks, plates, rollers, and types and dies, by which various patterns, devices, and compositions, can be effectually imprinted and impressed upon cotton, linen, silk, worsted, mohair, and woollen cloths, or on any fabric made of a mixture of any two or more of them, also on paper, leather, porcelain, and earthen-ware, at a considerable less expense than by any other process now used for these purposes. Dated September 30, 1816.

John Aston Wilkes, of Birmingham, Warwickshire, Glass Toy-manufacturer; for a method of manufacturing glass icicles, spangles, and every other description of ornamental glass, with a loop or loops of the same material. Dated September 30, 1816.

William Losh, of Newcastle-upon-Tyne, Iron-founder, and **George Stephenson**, of Killingworth, Northumberland, Engineer; for a method or methods of facilitating the conveyance of carriages, and all manner of goods and materials, along rail-ways and frame-ways, by certain inventions and improvements in the construction of the machine, carriages, carriage-wheels, rail-ways, and frame-ways, employed for that purpose. Dated September 30, 1816.

END OF THE TWENTY-NINTH VOLUME.

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